8010M

Digital Multimeter

Instruction Manual

FLUKE®

NOTE

This manual documents the Model 8010M and its assemblies at the revision levels shown in Appendix 7A. If your instrument contains assemblies with different revision letters, it will be necessary for you to either update or backdate this manual. Refer to the supplemental change/errata sheet for newer assemblies, or to the backdating sheet in Appendix 7A for older assemblies.

8010M
Digital Multimeter

Instruction Manual

P/N 649319
July 1982
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*For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, Washington 98206

Rev. 6/81

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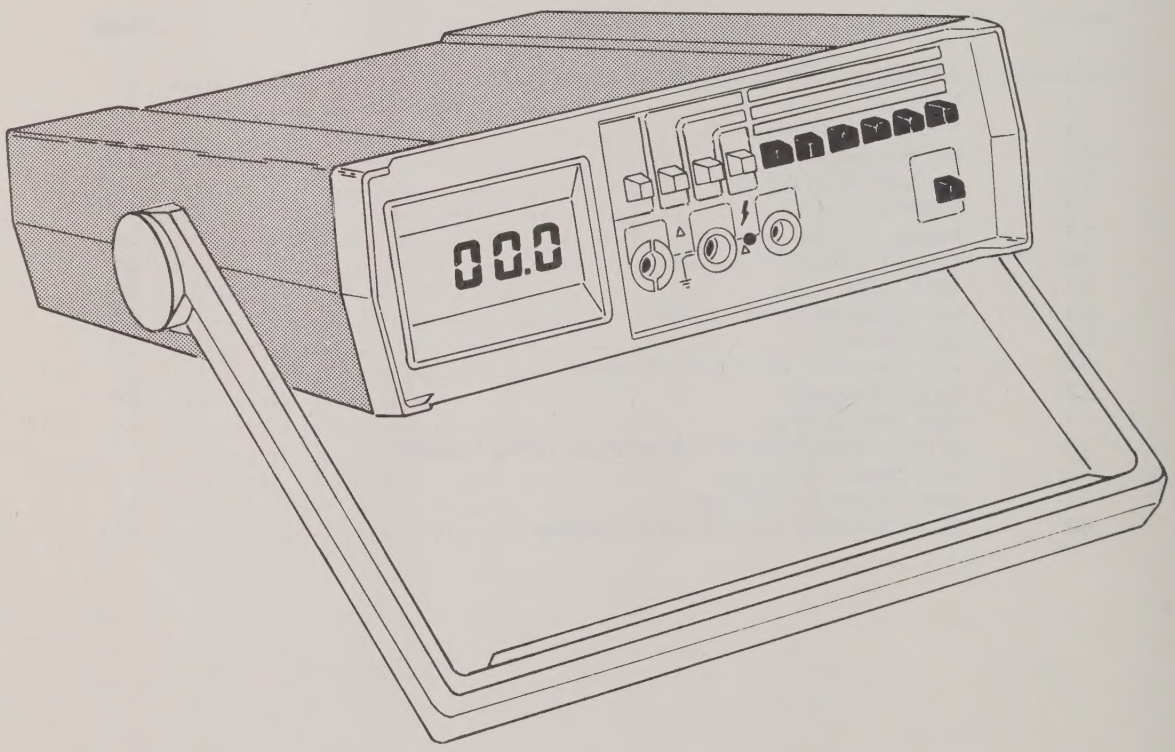


8010M Digital Multimeter

Section 1
Introduction & Specifications

1-1. INTRODUCTION

NOTE

The Model 8010M-01 is a Model 8010M with a rechargeable battery pack installed. The battery pack is described in this manual as Option -01. A detailed description of the option is given in Section 6.

1-2. The Fluke Model 8010M is a portable, bench-type, digital multimeter with a 3-1/2 digit liquid crystal display (LCD). Its standard measurement functions include the five basic DMM functions: AC/DC voltage, AC/DC current, and resistance.

1-3. Your meter also has advantages that don't show on the outside. Some of these are:

- True RMS measurement of AC signals-the only accurate way to directly measure ac signals other than noise-free pure sine waves.
- 3-1/2 digit liquid crystal display - a high contrast display that can be easily read from across the room. No more worries about bent needles, parallax, etc.
- Each range has:

  Full auto-polarity operation.

  Overrange indication.

  Effective protection from overloads and transients.
- Dual slope integration measurement technique to insure fast, accurate, noise-free measurements.
- Long term calibration stability - 1 year. Easy calibration - few adjustments.
- A full line of accessories that extend the range and scope of your instrument:

  Touch and Hold Probe allows voltage and resistance readings to be held in the display.

  High Current Probe allows your meter to measure from 2A to 600A.

  Two high voltage probes allow your meter to measure from either 1 kV to 40 kV dc or peak ac, or 0 to 6 kV dc or peak ac.

  Two high frequency probes allow your meter to measure signals from 0.25V to 30V rms ac over a frequency range of either 100 kHz to 100 MHz or 100 kHz to 500 MHz.

  Temperature Probe allows your meter to measure temperature of -50°C to +150°C or -58°F to +302°F.
- Rechargeable Battery Pack is available as Option -01.

NOTE

For more information on these accessories, refer to the material presented in Section 6.

1-4. UNPACKING YOUR INSTRUMENT

1-5. The shipping container should contain this manual, your multimeter, two test leads (one red and one black), and any accessories you have ordered. Turn the instrument upside-down. The large decal on the bottom of the unit is marked with the line voltage and line frequency required for operation. The marked values should agree with your order. If anything is wrong with your shipment or if the instrument was damaged during shipment, follow the special instructions for inspection and claims that are printed on the shipping container. If

reshipment is necessary, use the original container. If the original container is not available, order a new container from John Fluke Mfg. Co., Inc.; P.O. Box C9090, Everett WA 98206; telephone (206)342-6300.

1-6. GETTING ACQUAINTED

1-7. Let's take a brief look at your instrument before we discuss exactly how to operate it.

1-8. The meter is light (3 pounds and 6 ounces) with a low profile that hugs the work bench. The light grey case goes with any decor and is made of rugged, high impact plastic. The handle can be rotated to eight positions to function as a handle for carrying the instrument or as a stand to tilt the front panel up for convenient operation. Or, the handle can be rotated out of the way. To change the handle position, pull out on the round hubs where the handle joins the meter then rotate the handle to the desired position.

1-9. On the rear of the meter are a phillips screw and a power cord receptacle. The phillips screw holds the outer cover in place.

1-10. The LCD (liquid crystal display) covers the left part of the front panel. The right-hand portion of the front panel contains two horizontal rows of controls and connectors. The top row consists of 10 pushbutton switches - the four switches on the left allow selection of the measurement function, and the other six switches allow selection of the measurement range. The bottom row consists of the input terminals and the POWER switch.

1-11. USING YOUR METER

1-12. This portion of the text contains a description of the operation of each measurement function and its characteristics. Exercises are included to familiarize you with the instrument and to ensure that your instrument is functional.

1-13. The LCD

1-14. The LCD is a 3-1/2 digit display. As shown in Figure 1-1,this display is made up of four digits. The three digits on the right can each register a count of 0 to 9. Together they register from 000 to 999. The digit on the left can register the minus sign and a 1 overflow from the three digits on the right. This is the 1/2 digit. Together the display digits can range from -1999 to + 1999 (the + sign is not displayed). For convenience of discussion, we will round the 1999 to 2000.

1-15. Power Switch

1-16. The POWER switch is the green switch in the lower right corner of the front panel. As the decal indicates, the pushbutton has two positions ON (in) and OFF (out). To change from one position to the other, push the switch (never pull). If the pushbutton is in the OFF position (out) push it; it will lock in the ON (in) position. Press the pushbutton again, it will return to the OFF (out) position.

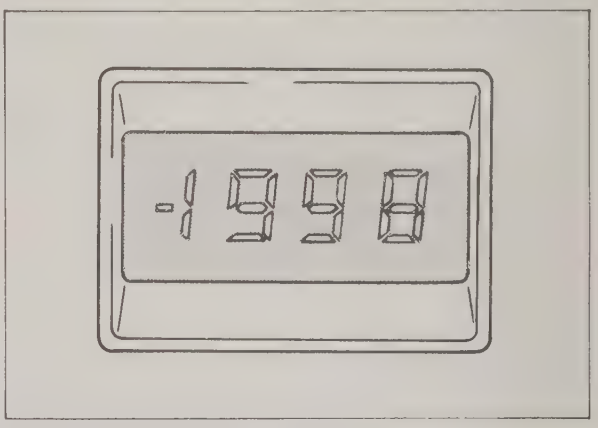


Figure 1-1. LCD

1-17. AC/DC Select

1-18. The position of the pushbutton at the left end of the upper row of controls determines whether your instrument will read dc or ac signals. Operation of this control is exactly like the POWER switch. As the decal shows, if the pushbutton is in, ac measurement is selected. If the pushbutton is out, dc measurement is selected. This control will only affect your instrument when either a voltage or current function is selected.

1-19. Voltage Measurements

1-20. The controls and terminals used for making voltage measurements are highlighted in Figure 1-2. Starting at the top-left is the AC/DC pushbutton. Next is the V pushbutton. This pushbutton is interlocked with two other white measurement function select switches, mA and kΩ. That is, if the V pushbutton is locked at the in position and either of the other two pushbuttons are pressed, the V pushbutton will pop to the out position. The pushbutton must be locked at the in position to determine measurement function.

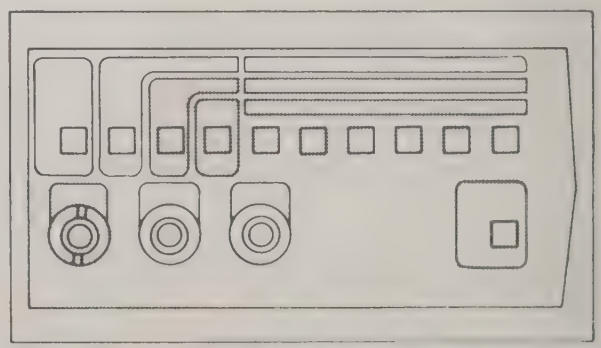


Figure 1-2. Voltage Measurement

1-21. The light green decal around the V control extends up and to the right. The five ranges of the voltage function are labeled in this green band over their respective range selection switches. These switches are all interlocked in the same manner as the three measurement function switches.

1-22. The two input terminals highlighted in the bottom row are banana jack connectors. The one on the left is labeled COMMON and has a black decal. This terminal is common to all measurement functions and the black test lead should always be connected here. A curved line with a note goes to the left and down from the COMMON input terminal. This note is a reminder to not measure signals where the COMMON lead will be more than 1200V peak above ground potential. The other input terminal is labeled V/kΩ on a red decal. The red test lead is connected here for voltage and resistance measurements. Between the two terminals is a hole and a thin connecting line with a subtended note. The note reminds the operator that signals exceeding 1200V ac or dc should not be measured between the terminals. The hole is a pin guide for the optional Touch and Hold Probe.

1-23. Let's perform the following procedure.

1. With the POWER switch in the OFF position, connect the power cord to the instrument and a line power outlet rated at the operating voltage and frequency of your instrument.

2. Set the AC/DC switch to the DC position.

3. Select the volts function, V.

4. Select the 2V range.

5. Connect the test leads to the input terminals (red to V/kΩ, black to common).

6. Press the POWER switch to ON. The LCD should flash a random number. Then count down rapidly to a reading of .000 (because the 2V range is selected).

7. Touch the probe tip of the red test lead to the far left terminal labeled mA. A firm contact must be made or the display may be in error. The LCD should display approximately 0.6V to 0.8V. This is the signal voltage for the optional Touch and Hold Probe. It is not an accurate voltage level and varies from instrument to instrument. This voltage is not present when a current measurement function is selected. For more information on the Touch and Hold Probe, refer to Section 6.

8. Set the AC/DC switch to the AC position. The LCD should count down to a reading that is typically .000 to .001 - the dc signal has been eliminated.

9. Remove the red test lead from the mA input terminal.

10. Select the 1200V ac rms range.

WARNING

THE LINE VOLTAGE IS MEASURED IN THE FOLLOWING STEP. BE CAREFUL NOT TO TOUCH THE PROBE TIPS WITH YOUR FINGERS OR TO ALLOW THE PROBE TIPS TO TOUCH EACH OTHER.

11. Insert the probe tips of the test leads into opposite slots of a line power outlet. The LCD should display the magnitude of the line voltage. This voltage probably will not be at the rated level but should be close.

12. Set the AC/DC switch to the DC position. This will reject the ac portion of the signal. There may be some dc voltage displayed due to non-linear loads such as SCR light dimmers.

13. Remove the test leads from the line power outlet.

1-24. Current Measurements

1-25. The controls and terminals used for making current measurements are highlighted in Figure 1-3. The AC/DC switch and the mA switch are used to select the current measurement function.

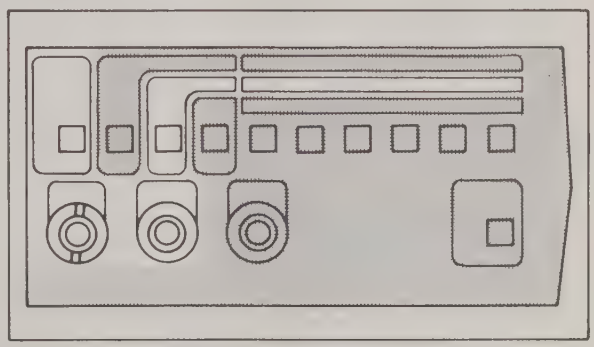


Figure 1-3. mA Measurement

1-26. The pink decal around the mA control extends up and to the right. The ranges of current measurement are labeled in this pink band above their respective range selection switches.

1-27. The two input terminals used for making current measurements are labeled COMMON and mA. There is a

line between them with a note to remind the operator that current measurements should not exceed 2A. The mA terminal is also the end of protective fuse holder. The collar of the terminal is slotted to facilitate fuse replacement. There is a curved arrow with a 2A fuse note to the left of the mA terminal to indicate how to remove the 2A fuse. For additional information on fuse replacement, refer to Section 2.

1-28. Resistance Measurements

1-29. The controls and terminals used for making resistance measurements are highlighted in Figure 1-4. The resistance measurement function is selected by pressing the kΩ switch. The tan decal extends up and to the right with the six ranges of resistance labeled over their respective pushbuttons. The COMMON and V/kΩ terminals are used for signal input.

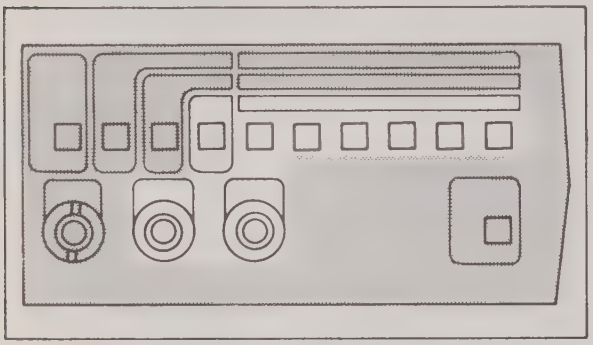


Figure 1-4. Resistance Measurement

1-30. Let's use the following procedure to exercise the resistance function and see how the range switches affect the position of the decimal point on the display.

1. Select the resistance function, 2000 kΩ range.

2. The LCD should display an overrange indication, a 1 with the three right-hand digits blank.

3. Connect the test leads to the input terminals, black to COMMON and red to V/kΩ .

4. Make a firm connection between probe tips. The LCD should count down to a reading of 000.

5. While maintaining a firm contact between the sampling ends of the test leads, sequentially select each of the six resistance ranges starting with 200Ω. The decimal point for each range should be as follows:

200Ω	00.0*	200 kΩ	00.0
2 kΩ	.000	2000 kΩ	000
20 kΩ	0.00	20 mΩ	0.00

*Display may display .1 or .2 ohms of lead resistance.

1-31. SPECIFICATIONS

1-32. Detailed specifications for the 8010M are given in Table 1-1. Specifications for the Battery Pack (Option -01) are given in Section 6.

Table 1-1. 8010M Specifications

These electrical specifications assume an operating temperature of 15°C to 35°C, humidity up to 80%, and a 1-year calibration cycle.

ELECTRICAL FUNCTIONS ..... DC Volts, AC Volts, DC Current, AC Current, and Resistance.

DC Volts

RANGE, RESOLUTION, AND ACCURACY

RANGE	RESOLUTION	ACCURACY for 1-Year
±200 mV	100 μV	±(0.1% of reading + 1 digit)
±2V	1 mV	
±20V	10 mV	
±200V	100 mV	
±1200V	1V	

TEMPERATURE COEFFICIENT
(-10°C to 15°C and 35°C to 55°C) .... ±(.01% of reading + .005% of F.S.)/°C

INPUT IMPEDANCE ..... 10 MΩ, all ranges.

NORMAL MODE REJECTION RATIO . >60 dB at 60 Hz (or at 50 Hz on 50 Hz Units) and multiples thereof

Table 1-1. 8010M Specifications (cont)

COMMON MODE REJECTION RATIO (1 kΩ unbalance) >120 dB at dc, 50 Hz and 60 Hz.

OVERVOLTAGE PROTECTION ..... 1200V rms or 1700V peak on all ranges.

RESPONSE TIME ..... 1/2 second.

AC Volts (True RMS Responding)

RANGE, RESOLUTION, AND ACCURACY

RANGE	RESOLUTION	ACCURACY FOR 1 YEAR		
		45 Hz to 10 kHz	10 kHz to 20 kHz	20 kHz to 50 kHz
200 mV	100 μV	± (0.5% of reading + 2 digits)	±(1.0% of reading + 2 digits)	±(5% of reading + 3 digits)
2V	1 mV			
20V	10 mV			
200V	0.1V			
1200V	1V	±(0.5% of reading +2 digits)		

TEMPERATURE COEFFICIENT (-10°C to 15°C and 35°C to 55°C) .... ±(.01% of reading + .005% of F.S.)/°C

VOLT-HZ PRODUCT ..... 10^7 max (500V max @ 20 kHz).

EXTENDED FREQUENCY RESPONSE Typically ±3 dB at 200 kHz.

COMMON MODE NOISE REJECTION RATIO (1 kΩ UNBALANCE) ..... >60 dB at 50 Hz and 60 Hz.

CREST FACTOR RANGE ..... 1.0 to 3.0.

INPUT IMPEDANCE ..... 10 MΩ in parallel with <100 pF.

OVERLOAD PROTECTION ..... 1200V rms or 1700V peak continuous not to exceed 10^7 volt-hertz product on the 20, 200, and 1200 ranges; 500V rms on the 200 mV and 2V ranges.

RESPONSE TIME ..... 3 seconds maximum within a range.

DC CURRENT

RANGE, RESOLUTION, ACCURACY, AND BURDEN VOLTAGE

RANGE	RESOLUTION	ACCURACY FOR 1 YEAR	BURDEN VOLTAGE
20 μA	0.1 μA	±(0.3% of reading + 1 digit)	0.3V max
2 mA	1 μA		
20 mA	10 μA		
200 mA	100 μA		
2000 mA	1 mA		0.9V max

TEMPERATURE COEFFICIENT (-10°C to 15°C and 35°C to 55°C) .... ±(.015% of reading + .005% of F.S.)/°C

OVERLOAD PROTECTION ..... 2A/250V fuse in series with 3A/600V fuse (for high energy sources).

RESPONSE TIME ..... 1/2 second.

Table 1-1. 8010M Specifications (cont)

AC Current (True RMS Responding)

RANGE, RESOLUTION, ACCURACY, AND BURDEN VOLTAGE

RANGE	RESOLUTION	ACCURACY FOR 1 YEAR			BURDEN VOLTAGE
		45 Hz to 3 kHz	45 Hz to 10 kHz	10 kHz to 20 kHz	
200 μA	0.1 μA	±(1% of reading + 2 digits)		±(2% of reading + 2 digits)	0.3V rms max
2 mA	1 μA				
20 mA	10 μA				
200 mA	100 μA				
2000 mA	1 mA	±(1% of reading + 2 digits)			0.9V rms max

TEMPERATURE COEFFICIENT
(-10°C to 15°C and 35°C to 35°C) .... ±(.015% of reading + .005% of F.S.)/°C

OVERLOAD PROTECTION ..... 2A/250V fuse in series with 3A/600V fuse (for high energy sources).

CREST FACTOR RANGE ..... 1.0 to 3.0.

Resistance

RANGE, RESOLUTION, ACCURACY, AND LIMITS

RANGE	RESOLUTION	ACCURACY FOR 1 YEAR	FULL-SCALE VOLTAGE	MAXIMUM TEST CURRENT
200Ω	0.1Ω	±(0.2% of reading +1 digit)	<0.25V	1.3 mA
2 kΩ ⊣▶⊢	1Ω		>1.0V	1.3 mA
20 kΩ	10Ω		<0.25V	10 μA
200 kΩ ⊣▶⊢	100Ω		>1.0V	35 μA
2000 kΩ	1 kΩ		<0.25V	0.10 μA
20 MΩ ⊣▶⊢	10 kΩ	±(0.5% of reading + 1 digit)	>1.5V	0.35 μA

TEMPERATURE COEFFICIENT
(-10°C to 15°C and 35°C to 55°C) .... ±(.015% of reading +.005% of F.S.)/°C
except 20 MΩ range, ±(.02% of reading +.005% of F.S.)/°C

OVERLOAD PROTECTION ..... 300V dc/ac rms on all ranges.

OPEN CIRCUIT VOLTAGE ..... Less than 3.5V on all ranges.

RESPONSE TIME ..... 1/2 second, all ranges except 2000 kΩ and 20 MΩ ranges. 4 seconds these two ranges.

DIODE TEST ⊣▶⊢ ..... These three ranges have enough voltage to turn on silicon junctions to check for proper forward-to-back resistance. The 2 kΩ range is preferred and is marked with a larger diode symbol on the front panel of the instrument. The three non-diode test ranges will not turn on silicon junctions so in-circuit resistance measurements can be made with these three ranges.

Table 1-1. 8010M Specifications (cont)

ENVIRONMENTAL	
Operating Conditions	
TEMPERATURE	-10°C to 55°C
HUMIDITY	0 to 80%
Storage Conditions	
TEMPERATURE	(without batteries): -40°C to +75°C (-40°F to +140°F). (with batteries): -40°C to +60°C (-40°F to +122°F).
GENERAL	
Maximum Common Mode Voltage	1200V dc or peak ac
Power Requirements	90 to 132V ac or 200 to 264V ac, 50 or 60 Hz to 400 Hz.
LINE MODEL	2 watts
BATTERY MODEL	3.5 watts
Size	6.40 cm x 25.15 cm x 21.72 cm (2.52" x 9.90" x 8.55"). See Figure 1-5.
Weight	
LINE MODEL	1.08 kg (2 lb, 6 oz).
BATTERY MODEL	1.42 kg (3 lb, 6 oz)

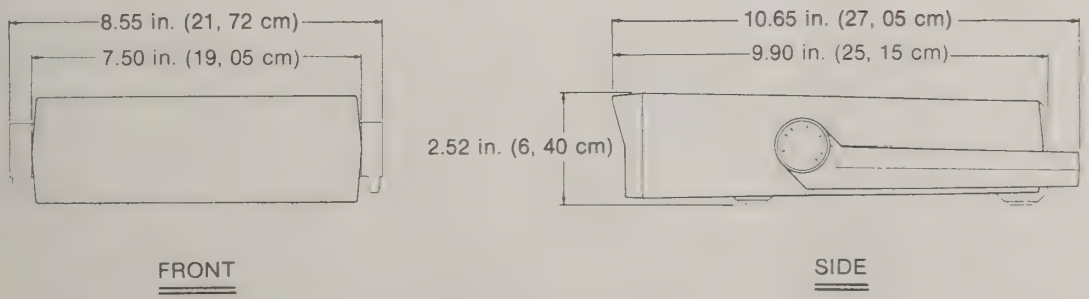


Figure 1-5. 8010M Dimensions

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section of the manual contains several notes, techniques, and procedures that will allow you to use your 8010M effectively. The emphasis is placed on measurement techniques and the interpretation of display data. Routine operator maintenance procedures are also given.

2-3. OPERATING NOTES

2-4. The operating notes contain information about measurement considerations, peculiarities of your instrument and some maintenance procedures. Every 8010A operator should be familiar with these operating notes.

2-5. Input Power

2-6. The standard power environment for the 8010M is 115V ac, 60 Hz. In addition, there is a battery pack option available that will operate off battery power or 90 to 264V ac, 50 Hz or 60 Hz. For more information about the battery version, see Option -01 in Section 6.

2-7. Display Readings

NOTE

The liquid crystal display used in the 8010M is rugged and reliable. With proper care, it will give you years of satisfactory service. Proper care includes these practices:

1. Protect the display from extended exposure to bright sunlight.

2. Keep the instrument out of high temperature and high humidity environments such as the dashboard of a car on a hot, sunny day.

3. Keep the instrument out of low temperature environments. Operation or storage at temperature below -15°C (5°F) may result in the display being sluggish until the instrument is returned to normal operating temperature.

2-8. The display on your meter will provide continuous readings during normal operation and indicate an overrange when an overload or overrange condition is encountered. The overrange indication is a 1 followed by three blank digits. (A decimal point may be present, depending upon the range selected.) This overrange indication doesn't necessarily mean that the input will damage your instrument. For example, when measuring resistance the overrange indication is displayed to indicate an open input condition.

2-9. During normal operation, the display reading is between zero and 1999. The position of the decimal point is determined by the range selected and is not affected by the measurement function selected. An indication of polarity is valid for both voltage and current measurements. The minus sign indicates that the input voltage or current is negative with respect to the COMMON input terminal. Voltage or current inputs that are positive with respect to COMMON are indicated by the absence of a minus sign.

2-10. There are two other conditions that will cause the negative sign to be displayed. Neither indicates a valid display. When your instrument comes out of an overrange condition, the minus sign may flash momentarily. This is most likely seen when reading resistance. When the test leads are not connected to anything, the meter will indicate an open condition (overrange indication). When the test leads are connected to an in-range resistance, the meter will come out of the overrange condition and the minus sign may flash. If you are reading resistance and the minus sign remains on,

there is still energy in the circuit being measured. The test circuit may still have power applied, a capacitor may still be charged, etc. You will only get this indication of an energized circuit if the power in the circuit is negative with respect to the COMMON input terminal. If the power in the circuit is positive with respect to the COMMON input terminal, an erroneous resistance will be displayed. If there is any doubt about whether there is energy remaining in the circuit you are reading, read the resistance, then reverse the test lead positions. If a minus sign is displayed in either case, the remaining energy must be removed from the circuit before correct resistance readings can be made.

2-11. Input Connections to COMMON

WARNING

TO AVOID ELECTRICAL SHOCK AND/OR INSTRUMENT DAMAGE DO NOT CONNECT THE COMMON INPUT TERMINAL TO ANY SOURCE OF MORE THAN 1200 VOLTS DC OR PEAK AC ABOVE EARTH GROUND.

2-12. Your instrument can be operated with the COMMON input terminal at a potential above earth ground of up to 1200V dc or 1200V peak ac. If this limit is exceeded, instrument damage may occur. This may present a safety hazard to the operator.

2-13. Input Overload Protection

CAUTION

Exceeding the maximum input overload limits can damage your instrument. The transient overload protection circuit is intended to protect against short duration high energy pulses. The components used limit the protection to approximately five pulses per second for 6 kV microsecond pulses, and about 0.6 watts average for lower pulses. Fast rep rate pulses as from a TV set can damage the protection components; RV1-RV3, R1, and R2. If these components require replacement, use only Fluke replacement parts to ensure continued product safety.

2-14. There are protection circuits for each measurement function and its associated ranges. Table 2-1 lists the overload limits for each function and range.

2-15. Fuse Replacement

2-16. The mA function of your meter is protected by a 2A, 250V fuse in series with a 3A, 600V fuse. If a current measurement exceeds the 2 amp limit the 2A, 250V fuse will blow first. If the open circuit voltage of the circuit being measured exceeds 250V causing the current to exceed 3 amps after the 2A fuse blows, the second fuse will blow protecting the circuitry of your instrument.

WARNING

TO AVOID ELECTRICAL SHOCK HAZARDS, DO NOT ATTEMPT TO ACCESS/REPLACE THE 3A, 600V FUSE UNLESS YOU ARE QUALIFIED TO DO SO.

2-17. The 3A, 600A fuse (F3) is only accessible when the cover is removed from the 8010M. A procedure for replacing this fuse is given in Section 4 of this manual. Refer the job to a qualified technician.

2-18. The 2A fuse (F1) is accessible from the front panel of the 8010M and may be checked/replaced by the operator. The following procedure provides the replacement instructions for the 2A fuse.

1. Insert a large coin or your thumbnail in the slot in the collar of the mA input terminal.

2. Turn the collar about 1/4 turn counter clockwise. (The direction shown by the arrow to the left of the mA input terminal). The collar should pop out about 1 cm.

Table 2-1. Input Overload Limits

FUNCTION SELECTED		RANGE SELECTED	INPUT TERMINALS	MAXIMUM INPUT OVERLOAD
V	DC	ALL RANGES	V/kΩ and COMMON	1200V dc or peak ac
	AC	20V, 200V, 1200V		1200V rms continuous
		2V, 200 mV		500V rms continuous
mA	DC or AC	ALL RANGES	mA and COMMON	Double fuse protected (2A, 250V fuse in series with a 3A, 600V fuse) when measurements are made in circuits having open circuit voltage of 600V or less.
kΩ		ALL RANGES	V/kΩ and COMMON	300V dc or ac rms

3. Pull the collar out of the instrument. The 2A/250V fuse is in the holder on the back of the collar. Replace it with an AGX 2A/250V fuse or the European equivalent (see Section 5).

4. Insert the collar/fuse assembly back into the front panel.

5. With your fingertip, push the collar all the way into the front panel and turn it clockwise until the collar will turn no farther (about 1/4 turn).

2-19. A line power fuse is not required in the standard 8010M. Input protection is designed into the power transformer. However, instruments that include the Battery Pack (Option -01) do contain a line power fuse (F3). The procedure for replacing F3 is given in Section 6.

2-20. Making Voltage Measurements

2-21. Section 1 described the operation of the controls and terminals used to make voltage measurements. To use your instrument effectively, there are other factors of which you should be aware. Some of these factors are discussed in the following paragraphs. Others will be covered later as AC Measurement Considerations.

2-22. Your instrument has five ac voltage and five dc voltage ranges: 200 mV, 2V, 20V, 200V, and 1200V ac or dc. All of these ranges have and input impedance of 10 MΩ. On the ac ranges, this input impedance is shunted by less than 100 pF. When you make voltage measurements, be sure you do not exceed the overload limits listed in Table 2-1.

2-23. CONVERTING VOLTAGE MEASUREMENTS

2-24. Your instrument is one of the new family of Fluke meters that actually measure the true rms value of an ac signal. This is a feature that allows accurate measurement of standard waveforms like distorted or mixed frequency sine waves, square waves, sawtooths, noise, and pulse trains (with a duty cycle of at least .1). In the past, the methods of ac measurements introduced large errors in the readings. Unfortunately, we've all grown used to these erroneous voltage readings and depend upon them to indicate whether or not a piece of equipment is working correctly. The data contained in Figure 2-1 should help you convert between the different measurement methods for the waveforms shown.

2-25. CIRCUIT LOADING ERROR

2-26. Any voltmeter connected across a circuit represents an additional load to the circuit. As long as the circuit resistance (source impedance) is small compared to the input impedance of the meter, the error is not significant. For example, when measuring voltage with your meter, as long as the source impedance is 10 kΩ or less, the error will be ≤0.1%. If circuit loading does present a problem, the percentage of error can be calculated using the appropriate formula in Figure 2-2.

2-27. Combined AC and DC Signal Measurement

2-28. The waveform shown in Figure 2-3 is a simple example of an ac signal riding on a dc level. To measure waveforms such as these, first measure the rms value of the ac component using the AC function of your meter. Measure the dc component using the DC function of your instrument. The relationship between the total rms value of the waveform and the ac component and the dc component is:

$$\text{RMS Total} = \sqrt{(\text{ac rms})^2 + (\text{dc})^2}$$

2-29. NOISE ERRORS

2-30. Many noise errors in dc voltage measurements are due to the line power frequency coupling into the circuit. Design features of your instrument have a noise rejection of approximately 60 dB (cut the noise to 1/1000 of its original level) when operated in the line-frequency environment for which it is designed. The decal on the bottom of your instrument is marked for the line-frequency that your instrument will reject (50 Hz or 60 Hz). Instruments are available with a switch selectable line-frequency circuit. If you have this type of instrument and wish to change the selected line-frequency rejection, refer the job to a qualified technician. The Line Frequency Selection procedure is given in Section 6 (Option -01) of this manual.

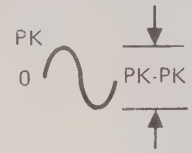
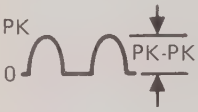
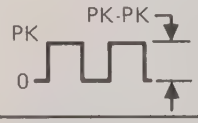
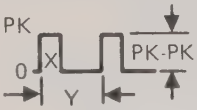
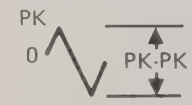
WARNING

TO AVOID ELECTRICAL SHOCK HAZARDS, DO NOT ATTEMPT THE LINE FREQUENCY SELECTION PROCEDURE UNLESS YOU ARE QUALIFIED TO DO SO. REFER THE PROCEDURE TO A QUALIFIED TECHNICIAN.

2-31. Making Current Measurements

2-32. The 8010M has five ac and five dc current ranges: 200 μA, 2 mA, 20 mA, 200 mA, and 2000 mA. All five ranges are diode protected up to 2 amps and fuse protected above 2 amps. If either or both of the protective fuses blow, refer to the Fuse Replacement information presented earlier in this section.

2-33. When a meter is place in series with a circuit to measure current, you may have to consider an error caused by the voltage drop across the meter (in this case, across the protective fuses and the current shunts). This voltage drop is called burden voltage. The full scale burden voltages for your instrument are 0.3V for the four lowest ranges and 0.9V for the 2000 mA range. These voltage drops can affect the accuracy of a current measurement if the current source is unregulated and the resistance of the shunt and fuse represents a significant part (1/1000 or more) of the source resistance. If burden voltage does present a problem, the error can be calculated using the formulas in Figure 2-4. This error can be minimized by selecting the highest current range that provides the necessary resolution.

AC-COUPLED INPUT WAVEFORM	PEAK VOLTAGES		METERED VOLTAGES			DC AND AC TOTAL RMS
			AC COMPONENT ONLY		DC COMPONENT ONLY	
	PK-PK	0-PK	RMS CAL*	8010M		TRUE RMS = $\sqrt{ac^2 + dc^2}$
SINE 	2.828	1.414	1.000	1.000	0.000	1.000
RECTIFIED SINE (FULL WAVE)	1.414	1.414	0.421	0.435	0.900	1.000
RECTIFIED SINE (HALF WAVE) 	2.000	2.000	0.764	0.771	0.636	1.000
SQUARE	2.000	1.000	1.110	1.000	0.000	1.000
RECTIFIED SQUARE 	1.414	1.414	0.785	0.707	0.707	1.000
RECTANGULAR PULSE  $D = X/Y$ $K = \sqrt{D - D^2}$	2.000	2.000	2.22K	2K	2D	$2\sqrt{D}$
TRIANGLE SAWTOOTH 	3.464	1.732	0.960	1.000	0.000	1.000

* RMS CAL IS THE DISPLAYED VALUE FOR AVERAGE RESPONDING METERS THAT ARE CALIBRATED TO DISPLAY RMS FOR SINE WAVES

Figure 2-1. Voltage Conversion

1. DC VOLTAGE MEASUREMENTS

Loading Error in % = 100 x Rs ÷ (Rs + 10^7)

Where: Rs = Source resistance in ohms of circuit being measured.

2. AC VOLTAGE MEASUREMENTS

First, determine input impedance, as follows:*

$$Zin = \frac{10^7}{\sqrt{1 + (2\pi F \cdot Rin \cdot C)^2}}$$

Where: Zin = effective input impedance
Rin = 10^7 ohms
Cin = 100 x 10^{-12} Farads
F = frequency in Hz

Then, determine source loading error as follows:*

$$\text{Loading Error in \%} = 100 \times \frac{Zs}{Zs + Zin}$$

Where: Zs = source impedance
Zin = input impedance (calculated)

*Vector algebra required

Figure 2-2. Circuit Loading Error Calculation

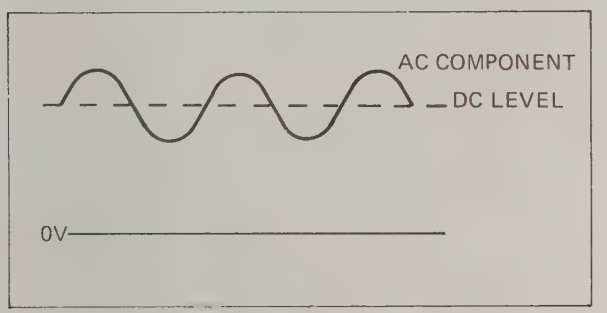
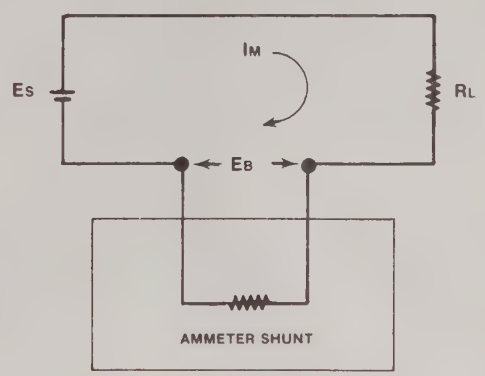


Figure 2-3. RMS Values

2-34. Making Resistance Measurements

2-35. The 8010M has six direct reading resistance ranges: 200Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2000 kΩ and 20 MΩ. For all ranges, the 8010M uses a two wire measurement technique so the readings will be in error by the amount of the resistance of your test leads.

2-36. A pair of standard test leads has a combined lead resistance on the order of 0.2 to 0.3 ohms. On the 8010M this low resistance only affects readings on ranges below 2 kΩ. To compensate for lead resistance, short the sampling ends of the test leads together and read the lead resistance. When making resistance measurements, subtract the measured lead resistance from the display reading and you will have an accurate resistance value.



E_S = Source voltage
R_L = Load resistance + Source resistance
I_M = Measured current (display reading in amps)
E_B = Burden voltage (calculated), i.e.
Display reading expressed as a % of full scale (100 x $\frac{\text{READING}}{\text{FULL SCALE}}$) times full scale burden voltage for selected range. See table.

RANGE	F.S. BURDEN VOLTAGE
2 mA to 200 mA	0.3V
2000 mA	0.9V
10A	0.5V

Current error due to Burden Voltage

$$\text{IN \%} = 100 \times \frac{E_B}{E_S - E_B}$$

$$\text{IN AMPS} = \frac{E_B \times I_M}{E_S - E_B}$$

Example: E_S = 14V, R_L = 9Ω, I_M = 1.497A,

$$E_B = 100 \times \frac{1497}{2000} \times 0.9 \text{ (from Table)} =$$

74.9% of 0.9 = 0.674V

$$\text{Error in \%} = 100\,\frac{.674}{14-.674} = 100\,\frac{.674}{13.326} = 5.06\%$$

Increase displayed current by 5.06% to obtain true current.

$$\text{Error in amps} = \frac{.674 \times 1.497}{14-.674} = \frac{.991}{13.326} = 0.074\text{A}$$

Increase displayed current by 0.074A to obtain true current

Figure 2-4. Calculating Burden Voltage Error

2-37. The three resistance ranges with a diode symbol beside the range value have a high enough open circuit voltage to turn on a silicon junction. These ranges (2 kΩ, 200 kΩ, and 20 MΩ) can be used to check silicon diodes and transistors. The 2 kΩ range is preferred. It is marked with the largest diode symbol. On the other ranges, the voltage is too small to turn on silicon junctions. Use these ranges to make in-circuit resistance measurements.

2-38. AC Measurement Considerations

2-39. When making precise measurements of ac signals, there are special parameters that must be considered such as the type of ac converter the meter uses (average, rms, etc.), crest factor, bandpass, and noise.

2-40. TRUE RMS

2-41. In order to compare dissimilar waveforms or calculate Ohm's law, or power relationships, you must know the effective value of a signal. If it is a dc signal, the effective value equals the dc level. However if the signal is ac, we have to borrow the root mean square technique from the world of statistics in order to find the effective value of the signal. In electronics, this effective value is called the root mean square or rms value of the signal. Classically, the rms value of a current or voltage is defined as being numerically equal to the dc current or voltage that produces the same heating effect in a given resistance that the ac current or voltage produces.

2-42. In the past, average responding converters were the type of converter most widely used. Theoretically, the rms value of a sine wave is $1/\sqrt{2}$ of peak value and the average value is 2/pi of the peak value. Since the meters converted to the average value, the rms value was $1/\sqrt{2} \div 2/\text{pi} = \text{pi}/2\sqrt{2} = 1.11$ of the average value when measuring a sine wave. Most meters used an average responding converter and multiplied by 1.11 to present true rms measurements of sine waves. As the signal being measured deviated from a pure sine wave the errors in measurement rose sharply. Signals such as square waves, mixed frequencies, white noise, and modulated signals could not be accurately measured. Rough correction factors could be calculated for ideal waveforms if the signal being measured was distortion free, noise-free, and a standard waveform. The true rms converter in the 8010M provides direct, accurate measurement of these and other signals.

2-43. CREST FACTOR

2-44. Crest factor range is one of the parameters used to describe the dynamic range of a voltmeter's amplifiers. The crest factor of a waveform is the ratio of the peak to the rms voltage with the dc component removed. In waveforms where the positive and negative half cycles have different peak voltages, the higher voltage is used in computing crest factor. Crest factors start at 1.0 for a square wave (peak voltage equals rms voltage).

2-45. The 8010M has a crest factor range of 1.0 to 3.0. If an input signal has a crest factor of 3.0 or less, the displayed voltage measurement will not be in error due to crest factor limitations. If the crest factor of a waveform is not known and you wish to know if it falls within the crest factor range of your meter, measure the signal with both your meter and an ac coupled oscilloscope. If the rms reading on your meter is 1/3 of the peak voltage on the waveform or more, then the crest factor is less than 3.0.

2-46. The waveforms in Figure 2-5 show signals with increasing values of crest factor. As you can see from the series of waveforms, a signal with a crest factor above 3.0 is unusual.

2-47. Rectangular waves, as usual, have their own special formula. It is:

$$\text{Crest Factor} = \sqrt{1/D\text{-}1}$$

Where D = duty cycle or the ratio of pulse width to cycle length. Using this formula we can prove that your meter can accurately measure pulse trains with a duty cycle above 10% without being limited by crest factor.

$$\begin{aligned} \text{Crest Factor} = \quad 3.0 &= \sqrt{1/D - 1} \\ 9.0 &= 1/D\text{-}1 \\ 10.0 &= 1/D \\ D &= 1/10 = 10\% \end{aligned}$$

2-48. BANDWIDTH

2-49. Bandwidth defines the range of frequencies where attenuation by the voltmeter's amplifiers and filters is no more than 3 dB down (half power levels). Your instrument has a bandwidth of up to 200 kHz on the 200 mV and 20V ranges and at least twice that on the 2V and 200V ranges. For brevity, let's call the bandwidth of your meter 200 kHz for these discussions.

2-50. SLEW RATE

2-51. Slew rate is also called the rate limit or the voltage velocity limit. It defines the maximum rate of change of the amplifier's output for a large input signal.

2-52. RISE AND FALL TIME EFFECT ON ACCURACY

2-53. The rise and fall times of a waveform are the length of time it takes a voltage level to change between the points that are 10% and 90% of the peak value. When discussing these periods, we'll only mention rise time. Errors due to rise or fall time can be caused either by bandwidth or slew rate. Slew rate should not affect measurements made with 8010M.

2-54. A good rule-of-thumb for converting the effects of bandpass into a rise time limit is to divide 0.35 by the high frequency value at the 3 dB point. For your instrument this will be 0.35/200 kHz = 1.75 μs. The following example will help you calculate errors due to this

limitation when measuring rectangular pulses. These calculations will be rough because ideal waveforms are used in the analysis.

WAVEFORM	CREST FACTOR
SQUARE WAVE	1.0
SINE WAVE	1.414
TRIANGLE SAWTOOTH	1.732
MIXED FREQUENCIES	1.414 to 2.0
SCR OUTPUT OF 100% – 10%	1.414 to 3.0
WHITE NOISE	3.0 to 4.0
PULSE TRAIN (t_0, T, t_0 = 1/10 T)	3.0
SPIKE	> 9.0

Figure 2-5. Crest Factor

2-55. Ideally, the rectangular pulses would have zero rise and fall times and would be the right angled waveform shown in Figure 2-6, Part A. In practice, every waveform has a rise and fall time and looks more like the waveform in Figure 2-6, Part B. When calculating the error caused by the bandpass of your instrument, we will assume worst case conditions where the rise and fall times equal the effect caused by bandpass, 1.75 μs. To do this, we will calculate the values for the theoretical signal with zero rise and fall times then calculate the values for a signal with the same period but with total slope periods equal to 1.75 μs. A comparison of the results will shown the measurement error due to the bandpass.

2-56. Look at the waveform in Figure 2-6, Part B. When using your meter to measure the ac component of the signal, the display will indicate the rms value of the ac signal riding on the dc level. (This dc level is the average value of the waveform when considered from the baseline.) The total rms value of the waveform can be calculated using the relationship:

$$E \text{ total rms} = \sqrt{E \text{ ac rms}^2 + E \text{ dc}^2}$$

There are long established formulas for computing the dc level and total rms values. Using Figure 2-6, Part B, for a reference, these formulas are:

$$E \text{ total rms} = A\sqrt{\frac{3t_0 + 2t_1}{3T}}$$

$$E \text{ dc} = A\left(\frac{t_0 + t_1}{T}\right)$$

Since we can calculate these two values to find what your meter measures, use the calculated values in this formula.

$$E \text{ ac rms} = \sqrt{(E \text{ total rms})^2 - (E \text{ dc})^2}$$

2-57. For our example let's use a 10 kHz pulse train with 50 μs pulses at a peak value of 1V. Ideally, the pulses would have a zero rise time as shown in Figure 2-7, A.

$$E \text{ total rms} = 1\sqrt{\frac{3(50) + 2(0)}{3(100)}} = \sqrt{\frac{150 + 0}{300}} = \sqrt{\frac{1}{2}}$$

$$E \text{ total rms} = 0.707$$

$$E \text{ dc} = 1\left(\frac{50 + 0}{100}\right) = \frac{50}{100} = 0.5$$

$$\text{So, the E ac rms} = \sqrt{(0.707)^2 - (0.5)^2} = \sqrt{0.50 - 0.25}$$

$$E \text{ ac rms} = \sqrt{0.25} = 0.5$$

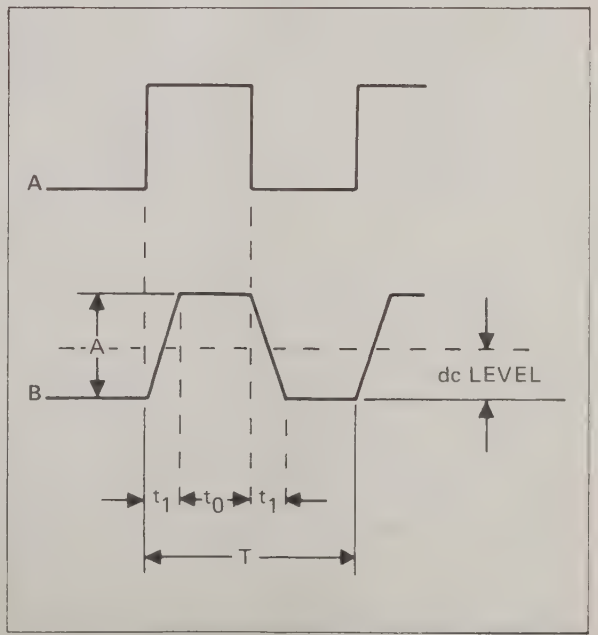


Figure 2-6. Components of a Rectangular Waveform

2-58. When the maximum distortion in rise time of 1.75 μs is assumed, the signal becomes the isoceles trapezoid waveform shown in Figure 2-7, Part B. In this case:

$$\text{E total rms} = 1\sqrt{\frac{3(48.25) + 2(1.75)}{3(100)}}$$

$$= \sqrt{\frac{144.75 + 3.50}{300}}$$

$$\text{E total rms} = \sqrt{\frac{148.25}{300}} = \sqrt{0.494} = 0.703$$

$$\text{E dc} = 1\left(\frac{48.25 + 1.75}{100}\right) = \frac{50}{100} = 0.50$$

$$\text{So, E ac rms} = \sqrt{(0.703)^2 - (0.50)^2}$$

$$= \sqrt{0.494 - .25}$$

$$\text{E ac rms} = \sqrt{0.244} = 0.494$$

Note that the E dc stayed the same.

So, the errors are:

In E total rms: - 0.6%

In E ac rms: - 1.2%

2-59. OPERATION

2-60. Operation of your instrument is easy:

1. Set the POWER switch to ON.

2. Set the function and range switches to the correct position for the measurement being made. (Refer to Section 1.)

3. Connect the test leads to the appropriate terminals. (Refer to Section 1.)

4. Contact the input signal with the sampling ends of the test leads and read the display.

5. Additional information for operating an 8010M equipped with a Battery Pack (Option -10) is given in Section 6.

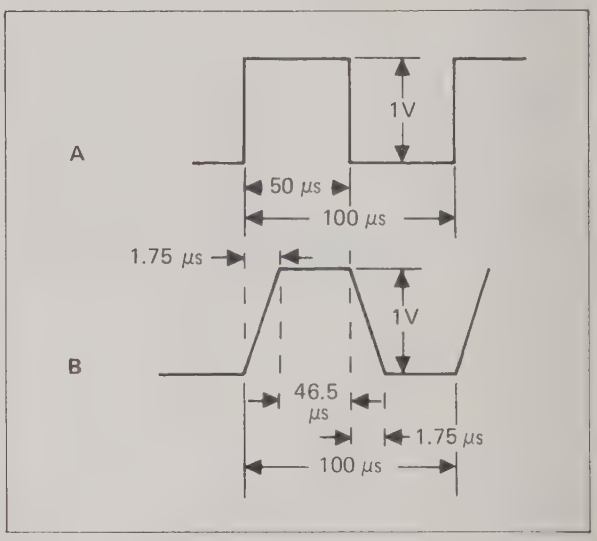


Figure 2-7. Sample Waveform

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section of the manual contains a functional description of the 8010M. Even if you never repair or calibrate the 8010M yourself, understanding how it works will enable you to get the most out of your instrument. The theory of operation is presented in two parts: a basic overall description of the functional sections of the instrument and a more detailed description of each functional section. If the 8010M contains a Battery Pack (Option-01), refer to Section 6 for additional theory of operation.

3-3. BASIC DESCRIPTION

3-4. As Figure 3-1 shows, the heart of your Fluke multimeter is a digital voltmeter that can measure DC voltages from –2V to +2V or +200mV to –200 mV very accurately. This voltmeter is composed of a custom IC and the LCD (Liquid Crystal Display). The custom IC contains an analog/digital converter, a controller, and the LCD drivers. An unknown analog voltage is converted to a digital representation by the a/d converter. The controller calculates the value of the input in units of the selected function and range and controls the a/d converter. The LCD drivers cause the computed value of the unknown input to be displayed on the LCD.

3-5. The input signal conditioners convert the various input signals into a DC voltage between ±2V or ±200 mV that is proportional to the input. The rest of the circuitry either protects the multimeter from overloads and transients or produces the basic operating voltages for the instrument.

3-6. DIGITAL VOLTMETER

3-7. The custom IC, U3, and the 3-1/2 digit LCD are the digital voltmeter that is the heart of your instrument. The custom IC contains an a/d converter, a digital controller, and the display logic for the LCD. To function properly, the IC, U3, depends upon some external components to establish basic timing and analog levels. Basic timing is established by a quartz crystal, Y1. Resistors, capacitors and an external voltage reference establish the analog levels for the a/d converter.

3-8. The digital voltmeter has two ranges of measurement. If you select either the 200 mV or 20V ranges or their equivalent ranges in other functions, the digital voltmeter can read voltages from –200 mV to +200 mV. Selection of any other range will enable the digital voltmeter to read +2V to –2V.

3-9. A/D Converter

3-10. The a/d converter uses the dual slope integration method. Dual slope integration takes advantage of the natural laws governing the charge and discharge of capacitors. Basically, in dual slope integration, an unknown voltage is applied to a capacitor for a specific length of time. Then a known voltage of the opposite polarity is applied to the capacitor and the time it takes for the capacitor to discharge is measured. The discharge time is proportional to the level of the unknown input voltage. This method is extremely accurate, fast and noise-free.

3-11. To see how your instrument performs dual slope integration, we'll assume your instrument is a 60 Hz version with a range selected that enables the ±2V measurement function of the internal voltmeter. Figure 3-2 contains a simplified schematic of the a/d converter at the top and a timing diagram at the bottom. The circled switches in the simplified schematic represent FET switches operated by the digital controller. These FET switches and the three operational amplifiers are located inside U3. All other components are external to U3. The timing diagram shows the operation of the FET switches for one conversion cycle with unknown voltage inputs of 1/2 range, full range, and overrange. The conversion cycle is continuously repeated.

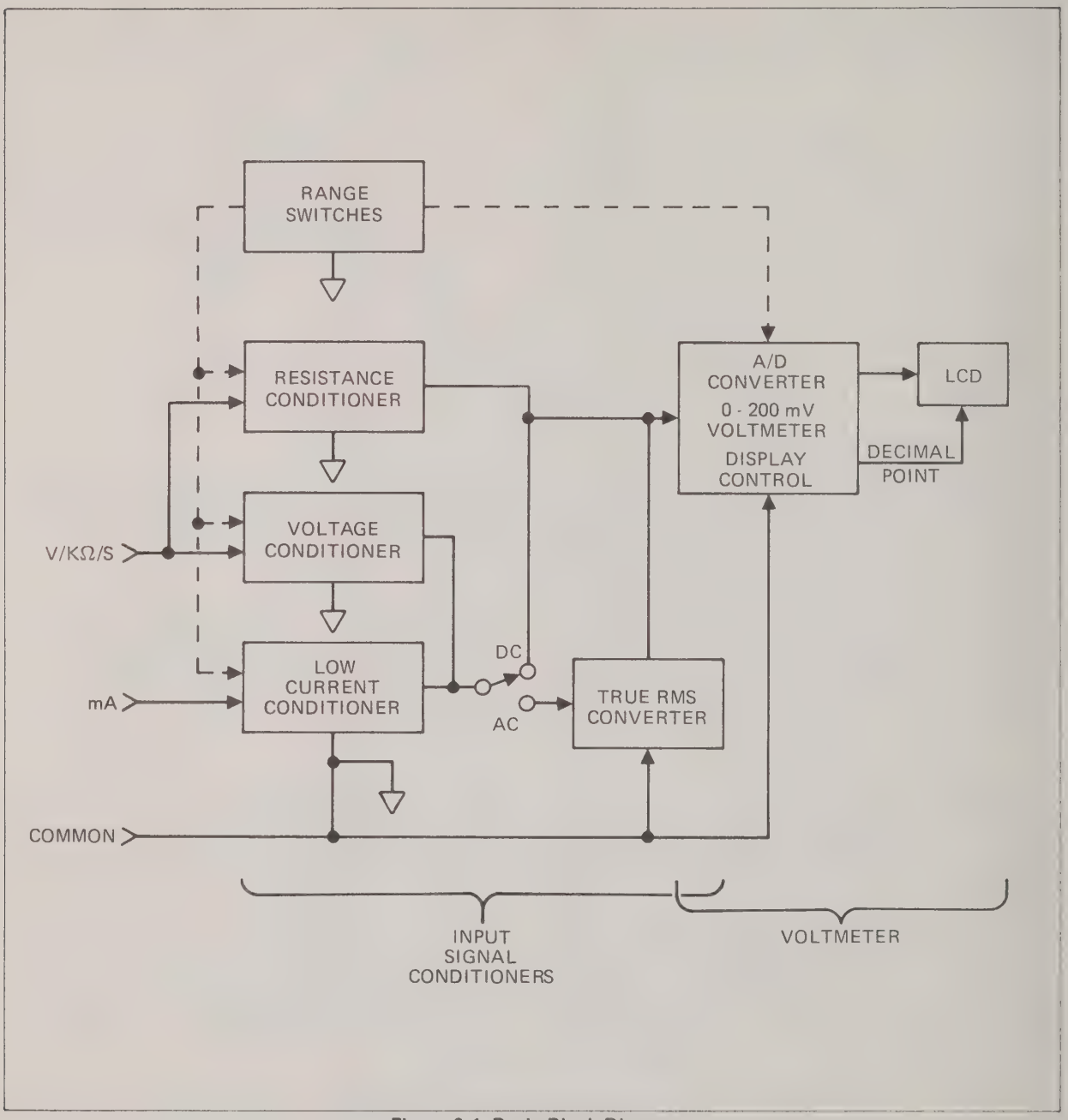


Figure 3-1. Basic Block Diagram

3-12. The basic clock frequency is 60 kHz. The 3.84 MHz from the quartz crystal is divided by 64 to produce the clock frequency. The timing diagram shown in Figure 3-2 uses the number of clock cycles counted as timing indicators. The conversion cycle is 20,000 cycles long or 1/3 of a second for the 60 Hz versions.

3-13. Let's put in an unknown voltage equal to 1/2 range and look at the a/d converter just before the integrate (INT) period begins. The auto-zero (AZ) is just ending so the a/d converter should be ready to receive a new input. The controller opens the AZ FETs and closes the INT FET. The input to the integrator and the comparator changes. The integration capacitor, C1, starts to charge. The comparator no longer has matched inputs so its output (CM) drops to a lower level. The integrate period lasts for a count of 1000. At the end of this time, the controller will open the INT FET and close the READ FET. At this time, C1 is charged to a level proportional to the level of the unknown input voltage

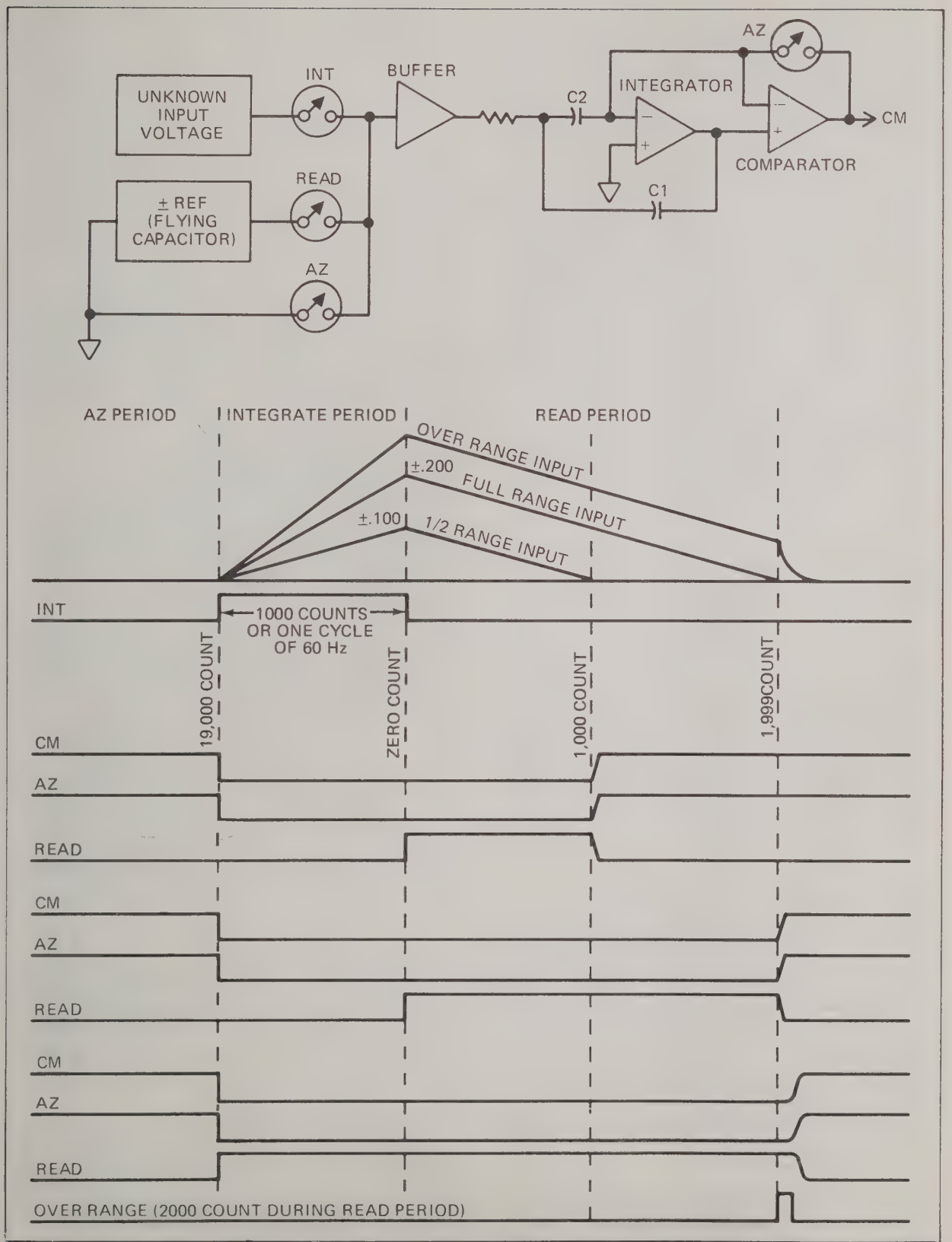


Figure 3-2. A/D Converter Simplified Schematic and Timing Diagram

3-14. Closing the READ FET applies the known reference voltage to the input of the integrator and the comparator. The polarity of this reference voltage is selected by the digital controller so that it is the opposite polarity of the unknown input voltage. C1 starts to discharge at a known rate. The digital controller starts to count clock pulses at the beginning of the read period. When C1 discharges to the level it was at when the integrate period started, the comparator reaches comparison and the CM level goes high. This CM level causes the controller to stop counting clock pulses, open the READ FET, and close the AZ FET. The controller now contains a digital count that is proportional to the level of the unknown input voltage. During the read period, the controller can count from 0 to 1999. Remember, when we discussed range, we rounded off to 2000 at the high end but it was actually 1999. Since we used an unknown input voltage equal to 1/2 range, the digital count will be 1000. The controller drives the display logic so that 1000 is displayed on the LCD. The location of the decimal point is determined by the position of the range switches. The LCD displays the unknown signal with the proper units.

3-15. Make the unknown input voltage equal full range. The read period is extended. At the time CM goes high, the digital controller has counted 1999 clock pulses. This is the maximum reading for any range.

3-16. Now, let's make the unknown input voltage some value that is greater than full range (overrange). Everything is normal until the digital controller counts 1999 clock pulses. At this time, C1 is still not discharged so the comparator output (CM) is still low. The digital controller counts one more clock pulse (2000 count). A count of 2000 generates an overrange pulse. This will display the overrange indication on the LCD and command the digital controller to start the auto-zero period.

3-17. During the auto-zero period, a ground reference is applied to the input of the a/d converter. Under ideal conditions, the output of the a/d converter would also go to zero. However, input-offset-voltage errors accumulate in the amplifier loop and appear at the comparator output as an error voltage. This error voltage is charged on C2 where it is stored for the rest of the conversion cycle. The stored level is used to provide offset voltage correction during the integrate and read periods. The auto-zero period starts at the end of READ and ends at the beginning of INT. The length of AZ can vary from a minimum of 17,000 counts (overrange) to a maximum of about 19,000 count (zero input)

3-18. the INT period is 1000 counts. With a clock frequency of 60 kHz, the INT period is exactly 1 cycle of 60 Hz long. We integrate all inputs to the a/d converter. So, the positive half cycle of the 60 Hz noise cancels out the negative half cycle of the 60 Hz noise. As we said before, this method is highly accurate, fast and noise-free.

3-19. If your instrument is a 60 Hz version and you select one of the ranges that enables the ±200 mV measurement function of the internal voltmeter, the a/d converter functions the same with two changes to the timing of the conversion cycle. The INT period is 10,000 counts long. Auto-zero is correspondingly shorter. At a clock frequency of 60 kHz, the 10,000 count length of the INT period means that it is 10 cycles of 60 Hz. Noise is cancelled.

3-20. The 50 Hz versions of the instruments function like the 60 Hz instruments except that a different quartz crystal is used as a reference for the clock frequency. The resulting clock frequency is 50 kHz. This means that 50 Hz noise is cancelled by the dual slope integration of the a/d converter.

3-21. Digital Controller

3-22. The digital controller is an integral part of the custom IC. It uses the reference frequency from the crystal as the basic clock. It controls the a/d converter and LCD drivers. It also monitors for an overrange input and turns on the overrange indication when necessary.

3-23. Display

3-24. The LCD is located in a mounting bracket fastened to the Main PCB. Its drivers are contained inside the custom IC. Overrange indications and numerical values originate from the custom IC. The decimal point is controlled separately by the range switches.

3-25. INPUT SIGNAL CONDITIONERS

3-26. The a/d converter in your instrument needs an input voltage between –2V dc and +2V dc. Any other input will result in an overrange condition. If you are measuring a dc voltage that falls within this range, the input signal conditioners are not used. But, to measure high voltages, current, ac signals, or resistance the input signal conditioners are used.

3-27. True RMS Converter

3-28. The rms converter in your Fluke meter is a hybrid circuit that converts the ac voltage from either the voltage or current conditioner into a dc voltage equal to the true rms value of the ac signal. This converter is designed to handle ac signals from 40 Hz to 50 kHz.

3-29. Voltage Conditioner

3-30. The voltage conditioner is a new design that provides wide bandpass with a very simple circuit. Part A of Figure 3-3 is simplified schematic of the front end of the 8010M when voltage measurements are being made. When either the 200 mV or the 2V range is selected, the input signal passes through the top range switch bypassing the voltage divider completely. (The

appropriate measurement function of U3 is enabled by the range switches too.) When either the 20V or 200V range is selected, the top range switch is in the down position and the bottom range switch is in the position shown. The portion of the input signal between R1 and R2 is used by your instrument. The voltage divider ratio is 1/100. Signals on the 20V range can now be measured by the 200 mV function of U3. When the 1200V dc range is selected, both range switches are in the down position. This places R3 in parallel with R2. The voltage divider ratio is now 1/1000. The input signals can now be measured by the 2V function of U3.

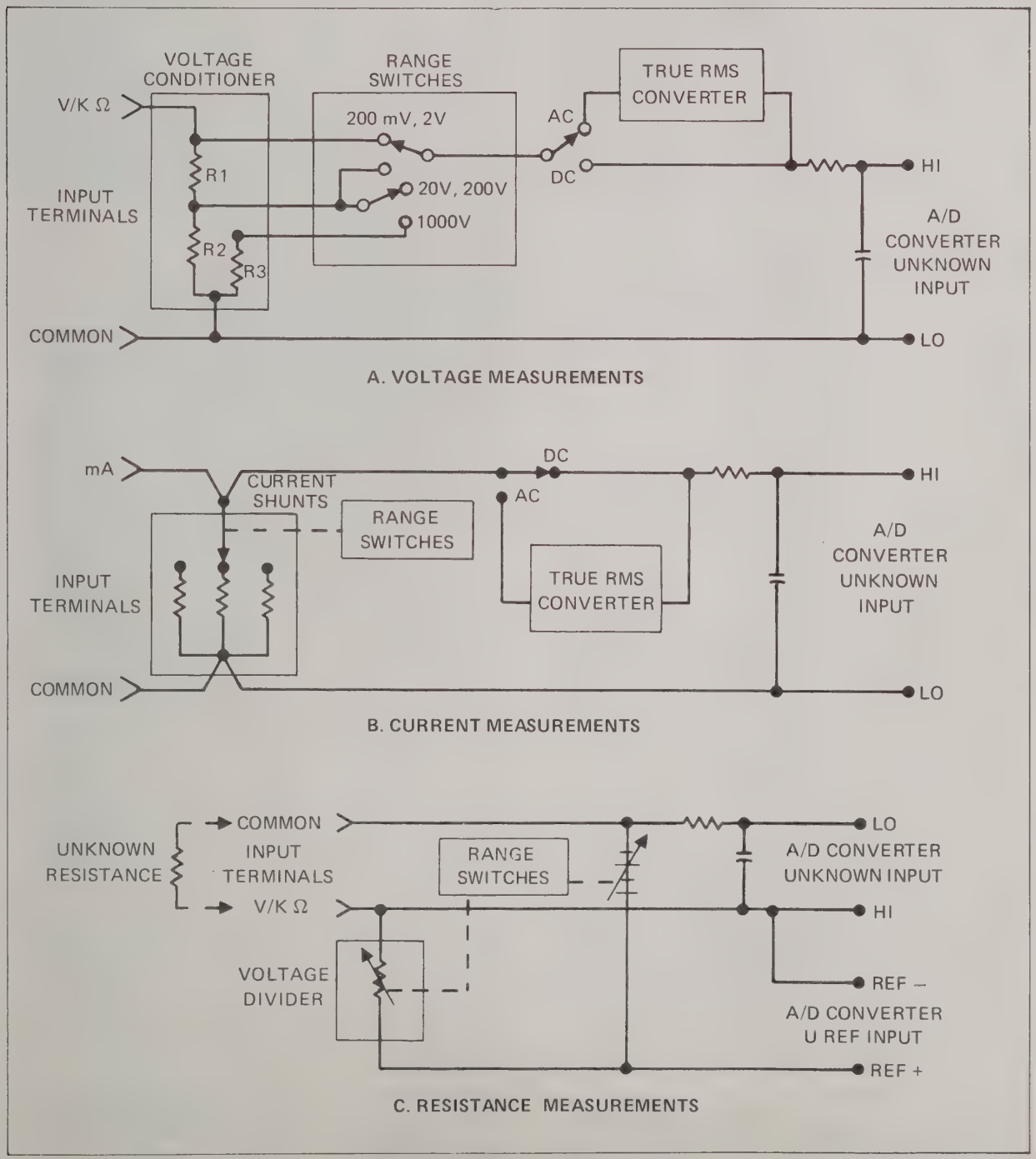


Figure 3-3. Input Signal Conditioners

3-31. Current Conditioner

3-32. The current conditioner changes a current level input into a voltage representation. This is done by passing the unknown current through a precision resistor and measuring the voltage developed across the resistor. If the proper resistance is selected, the voltage out of the current conditioner will be within the range required by the a/d converter. These resistors are a special type of high power precision resistors knows as current shunts. (They divert or shunt the current from the meter.) Part B of Figure 3-3 is a simplified schematic of your meter's front end when current measurements are being made. The range switches determine the combination of current shunts used for each range. The five current shunts are precisely 1000 ohm, 100 ohm, 1.00 ohm, and .100 ohm. The position of the AC/DC switch determines the route the voltage output of the current conditioner takes to reach the input of the a/d converter.

3-33. Resistance Conditioner

3-34. The resistance conditioner is the same voltage divider used in making voltage measurements. In measuring voltage or current the appropriate input signal conditioner did all the conversion of the input signal, the rest of the meter just measured the output of the signal conditioner. The resistance measurement is more complex.

3-35. The 8010M uses the ratio method to measure the value of an unknown resistance. Part C of Figure 3-3 is a simplified schematic of your instrument's front end when making resistance measurements. The resistance conditioner is used as a reference resistor and placed in series with the unknown resistance. V SOURCE is also placed in series with the resistors. The ratio of the resistance values equals the ratio of the voltage drops across the respective resistors. Once the a/d converter measures the voltage ratio, the value of the unknown resistance is easily determined.

$$\frac{R_{Unknown}}{R_{Reference}} = \frac{E_{Unknown}}{E_{Reference}}$$

3-36. The voltage drop across the unknown resistance is applied to the HI and LO inputs of the a/d converter. The voltage drop across the reference resistor is used as the reference voltage for the a/d converter. The range switches select the reference resistance (from the voltage divider) and V SOURCE so that the inputs to the a/d converter stay within the proper range of U3. The reference resistance is designed so that the output of the a/d converter displayed on the LCD is the value of the unknown resistance.

3-37. Range Switches

3-38. The range switches control the input signal conditioners so that the inputs to your meter can be processed properly. In addition to the functions we've already discussed, the range switches also position the decimal point in the display.

3-39. MISCELLANEOUS CIRCUITRY

3-40. Meter Protection Circuits

3-41. Have you ever tried to measure voltage with a resistance range selected on your meter? Or, have you tried to measure 6.5V on pin 15 only to find that someone had wired pin 15 to a 1200V source that should have been wired to pin 16? Most of us have. At times like these, meter protection circuits are essential. The protection circuits in the 8010M allow the instrument to absorb an unreasonable amount of abuse without affecting its performance. Even with catastrophic inputs, these protection circuits will fail safely, protecting the vital sections of your meter. We'll use the schematic of the Main PCB located in Section 8 to illustrate the description of the meter protection circuitry.

3-42. VOLTAGE MEASUREMENT PROTECTION

3-43. When the voltage measurement function is selected, all ranges on the 8010M can tolerate voltage inputs that are slightly higher than the highest input range. If the input voltage is higher than the display limits of the selected range, an overrange indication will be displayed. Once the input voltage exceeds about 1700V peak, the resistance of the five varistors (RV1 through RV5) drops, clamping the meter side of R2 to 1700V. These varistors can compensate for abusive transient voltage inputs of up to 6000V. Should the input voltage exceed 6000V and generate enough heat to destroy R2 (a flame-proof resistor), R16 (a 1 megohm, 1 watt, resistor) protects U3 from dc voltage inputs of up to 1000V (handy if a low range is selected). R14 is a 100 kilohm, 2 watt resistor that protects the inputbuffer of the rms converter for inputs up to 500V rms or 700V peak continuous for the 200 mV and 2V ranges. The input divider attenuation provides additional protection on all other ranges.

3-44. RESISTANCE MEASUREMENT PROTECTION

3-45. Selecting the resistance measurement function places Q1, Q2, and RT1 in parallel with the input meter and across the resistance input and COMMON lines. These three components provide protection for inputs up to 300V.

3-46. CURRENT MEASUREMENT PROTECTION

3-47. The mA input is protected two ways. CR1 and U4 limit the voltage drop across the current shunts. F1 and F2 protect the current shunts from overcurrent conditions. F1 is a fast blowing fuse rated for 2A, 250V. It is the type with a wire thread in an evacuated glass envelope. Under moderately abusive overloads, F1 will blow protecting the circuitry. But if the overload voltage is high enough, the voltage will arc through the metal vapor caused by F1 blowing and F2 will blow. F2 is rated for 3A at 600V.

3-48. Power Supply

WARNING

LINE VOLTAGE POTENTIAL IS ON THE PRIMARY POWER CIRCUIT ANY TIME THE INSTRUMENT IS PLUGGED INTO A LINE POWER OUTLET.

3-49. The standard instrument can be ordered with a power supply made to operate from either 115 or 230V ac, 50 Hz or 60 Hz. This power supply provides all basic operating voltages for the instrument. These voltages are rectified and filtered but are not regulated. All of the regulated voltage requirements are supplied either by U7 or by the custom IC, U3. The POWER switch opens and closes the secondary circuit. The power supply transformer, T1, is a special self-limiting transformer so the input is not fused.

3-50. A battery pack option is available for the 8010M. This option will operate from 90-264V, 50 Hz or 60 Hz (selectable). Refer to Option -01 in Section 6 for additional information.

3-51. Touch and Hold Circuit

3-52. The touch and hold circuit allows the accessory Touch and Hold Probe to be used with the 8010M. Look at the schematic of the Main PCB in Section 8. The CL2 line to crystal Y1 continues to the left, passing through Q4 and Q3 to ground. This path allows the crystal to oscillate. If a ground is applied to the mA terminal, Q3 is cut off. This stops the instrument clock. The last value displayed on the LCD remains displayed until the ground is removed from the mA terminal.

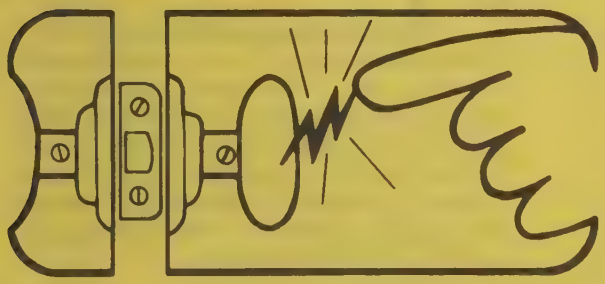
CAUTION

The Touch and Hold function is meant to be used for intervals of no more than a few minutes. If the display is stopped for longer periods of time (1/2 hour, 1 hour, etc.) the outline of the digits will remain for a few hours after the display is started again. If the display is stopped for extremely long periods of time, the LCD may be permanently damaged.

static awareness

A Message From

John Fluke Mfg. Co., Inc.



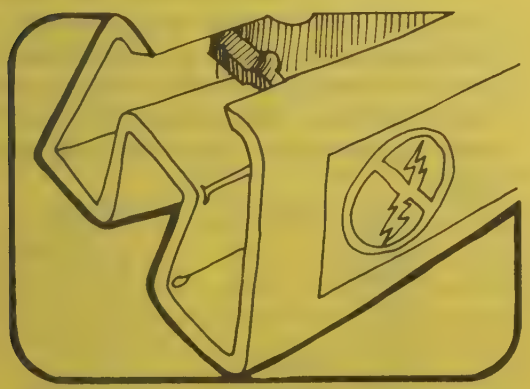
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

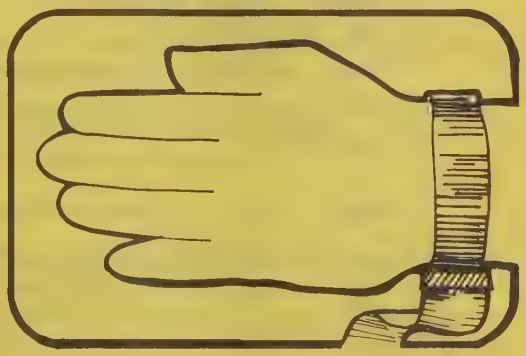
The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗"

The following practices should be followed to minimize damage to S.S. devices.

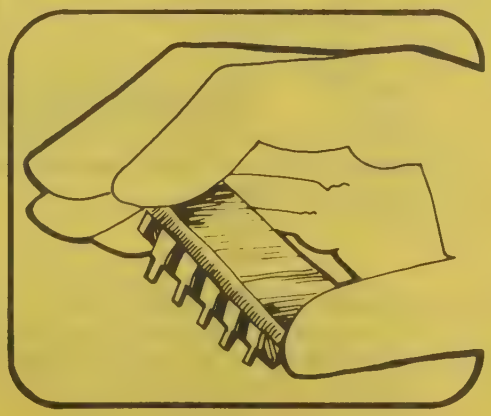
1. MINIMIZE HANDLING



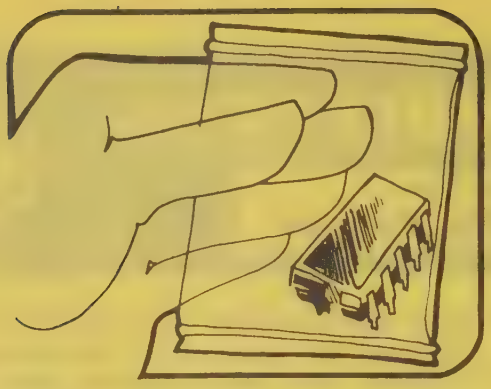
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



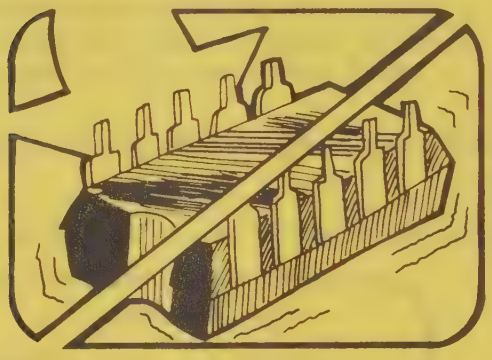
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



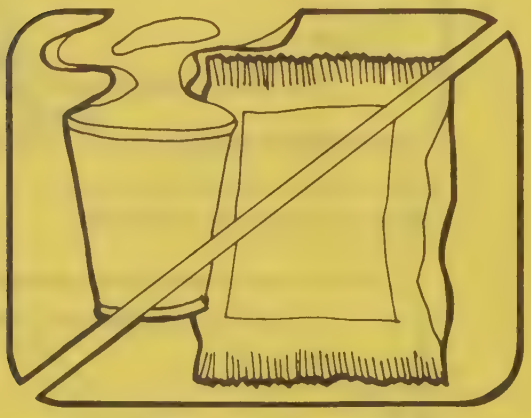
4. HANDLE S.S. DEVICES BY THE BODY



5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

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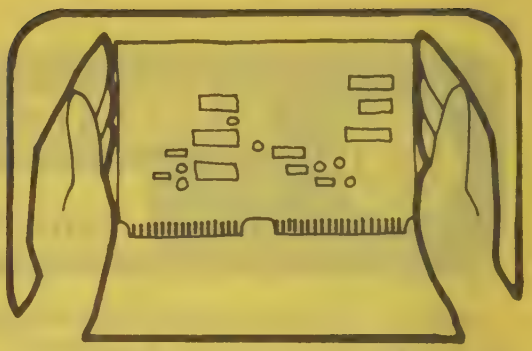
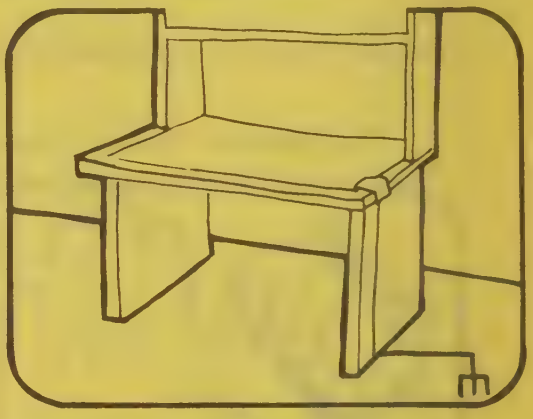
AND GENERAL DYNAMICS, POMONA DIV.

® Dow Chemical



8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR USUALLY PROVIDES COMPLETE PROTECTION TO INSTALLED SS DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION
10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.
11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Description
453522	6" X 8" Bag
453530	8" X 12" Bag
453548	16" X 24" Bag
454025	12" X 15" Bag
Pink Poly Sheet	Wrist Strap
30"x60"x60 Mil	P/N TL6-60
P/N RC-AS-1200	$7.00
$20.00	

J0089B-07U7810/SE EN Litho in U.S.A.

Section 4
Maintenance

WARNING

THESE SERVICE INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

4-1. INTRODUCTION

4-2. This section of the manual contains maintenance information for the 8010M Digital Multimeter. This maintenance information is divided into service information, general maintenance, a performance test, a calibration adjustment procedure, and troubleshooting. The performance test is recommended as an acceptance test when the instrument is first received, and later as a preventive maintenance tool to verify proper instrument operation. A 1-year calibration cycle is recommended to maintain the specifications given in Section 1. The test equipment required for both the performance test and calibration procedure is listed in Table 4-1. If the recommended equipment is not available, instruments having equivalent specifications may be used.

4-3. SERVICE INFORMATION

4-4. The 8010M is warranted for a period of 1-year upon delivery to the original purchaser. Conditions of the warranty are given at the rear of the manual.

4-5. Faults that occur within the limits of the warranty will be corrected at no charge. Simply mail the instrument (post paid) to your nearest authorized (in-warranty) Fluke Technical Service Center. Shipping information and a complete list of service centers are provided in Section 7. Dated proof-of-purchase will be required for all in-warranty repairs.

4-6. Factory authorized service centers are also available for calibration and/or repair of instruments that are beyond their warranty period. Contact your nearest authorized Fluke Technical Service Center for a cost quotation.

4-7. GENERAL INFORMATION

4-8. Access Information

NOTE

To avoid contaminating the pcb with oil from the fingers, handle it by the edges or wear gloves. If the pcb does become contaminated, refer to the cleaning procedures given later in this section.

4-9. CALIBRATION ACCESS

4-10. Use the following procedure to gain access to the calibration adjustments of your instrument:

1. Set the POWER switch to OFF.
2. Disconnect the power cord plug from the instrument.
3. Remove the phillips screw from the back of the instrument.
4. Slide the cover back until it is clear of the instrument.
5. Turn the instrument upside down.
6. All adjustments necessary to complete the calibration procedure are now accessible.

Table 4-1. List of Recommended Test Equipment

INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	RECOMMENDED MODEL
Multimeter Calibrator	DC Voltage: 0 to 1000V ± .05% AC Voltage: 100 Hz - 0 to 200V ± .05% 0 to 750V ± .8% 1 kHz - 0 to 250V ± .05% 10 kHz - 0 to 110V ± .3% 50 kHz - 0 to 20V ± .5% DC Current: 0 to 2000 mA ± .04% AC Current: 0 to 200 μA ± .01% Resistance: 0 to 10 MΩ in steps of power-of-ten ± .05%	John Fluke Model 5100A, John Fluke Model 5205A, John Fluke Model Y5000
DMM	Read true rms 0 to 12V ± 1%	John Fluke Model 8010A, 8012A, 8012A, 8020A or 8000A
Calibration Leads	One red, one black - 24" spade lug to banana connector	Pomona 1987-24

7. For reassembly, logically reverse this procedure.

4-11. MAIN PCB ACCESS

4-12. Use this procedure to remove the Main PCB:

1. Perform the calibration access procedure.

2. Remove the two screws from the rear of the bottom shield.

3. Remove the bottom shield.

4. Disconnect the front panel wires as follows:

a. The V/kΩ input line (white), and the COMMON input line (black), are attached to the front panel by a snap connector. Unplug these lines.

b. The mA input line (white) is more difficult to remove. It may either be unsoldered from the Main PCB or the following procedure may be used:

1. On the front panel, insert a coin or your fingernail into the slot on the mA terminal, turn the mA terminal 1/4 turn counter clockwise. Remove the fuse and holder.

2. Bend a small hook in the end of a paper clip (or equivalent).

NOTE

Perform the rest of this procedure carefully so the plastic walls of the fuse holder are not damaged.

3. Pull the wire up through the fuse holder slot.

4. Keep tension on the wire so that the rear end of the spring is as shown in Figure 4-1, Part A.

5. Insert the hook on the paper clip as shown in Figure 4-1, Part A. Pry gently upward until a few turns of the spring are free of the fuse holder.

6. Grasp the spring as shown in Figure 4-1, Part B, and turn it counterclockwise until it is free of the fuse holder.

7. Slide the spring down the wire to the Main PCB.

8. Push the wire back inside the slot in the fuse holder.

9. With the paper clip, pry the spring retainer free of the fuse holder as shown in Figure 4-1, Part C.

10. Pull the wire free of the slot in the fuse holder. Figure 4-1, Part D shows the mA input line free of the fuse holder.

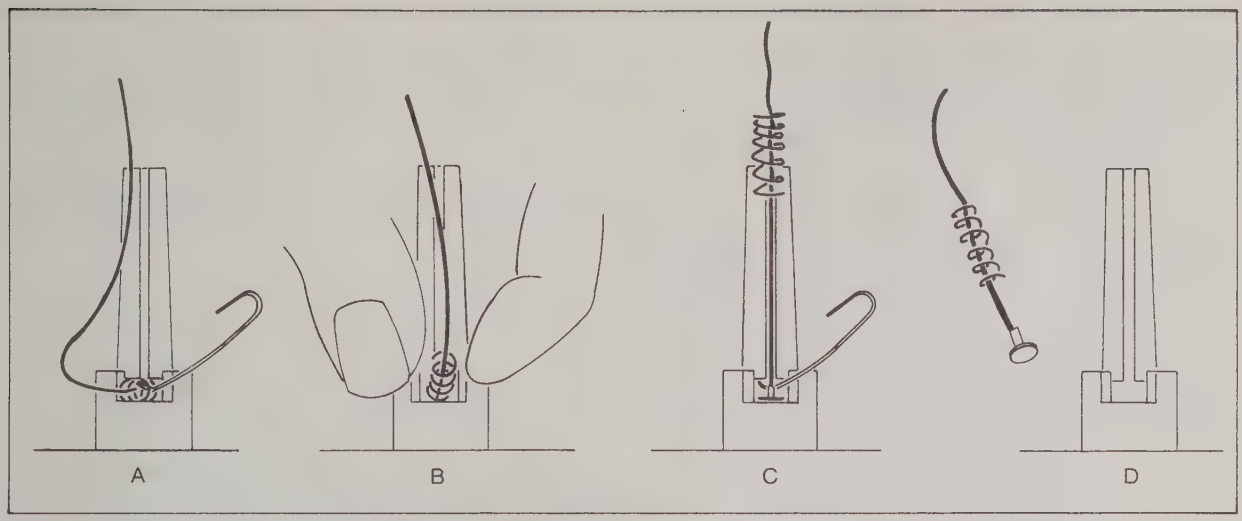


Figure 4-1. Removing the mA Input Lead

11. Reinstall the fuse and fuse holder.

6. Turn the instrument right side up.

7. Remove the two screws at the rear of the top shield and lift the top shield away from the Main PCB.

8. Remove the two screws that connect the Main PCB and the Front Panel Assembly. The screws are located at the front of the instrument, right side.

9. Carefully pull the front panel free of the switches.

10. To replace the Main PCB, logically reverse this procedure being careful to install the pcb and the shields in their appropriate guides.

4-13. DISPLAY ACCESS

4-14. Use the following procedure to remove or replace the LCD:

1. Perform the calibration access procedure.

2. Turn the instrument right side up.

3. Remove the two screws that connect the Main PCB and the Front Panel Assembly. The screws are located at the right front of the instrument.

4. Carefully slide the front panel forward until it is clear of the switches and the Display Assembly. Let the Front Panel Assembly drop clear of the Display Assembly.

5. Remove the two screws connecting the Main PCB and the Display Assembly.

6. Place your fingernail under the grey tabs on the display frame and lift them free of the white screwposts on the display mounting bracket.

7. Rotate the display fram forward and down until the two hooks on the bottom of the display frame release the display mounting bracket.

8. The LCD may now be lifted free from the display mounting bracket.

9. A small length of flat, flexible material may fall out. This is the zebra strip. The zebra strip is an elastomeric strip of alternate areas of conductive and non-conductive material. When the screws are tightened to hold down the display assembly, this zebra strip provides electrical contact between the pins on the LCD and the land pattern on the main PCB. The zebra strip is located in a channel on the display mounting bracket.

10. To replace the LCD, logically reverse this procedure.

4-15. Cleaning

CAUTION

Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. These solutions will react with the plastic materials used in the instrument.

CAUTION

Do not get the liquid crystal display wet. Remove the display assembly before washing the pcb and do not install it until the pcb has been fully dried.

4-16. Clean the front panel and case with a mild solution of detergent and water. Clean dust from the circuit board with clean, dry, low pressure air (20 psi). Contaminates can be removed from the pcb with demineralized water and a soft brush (remove the display assembly before washing the Main PCB and avoid getting excessive amounts of water on the switches). Dry the PCB with clean, dry, low pressure air, and then bake it at 50°C to 60°C (124°F to 140°F) for 24 hours.

4-17. Fuse Replacement

4-18. A detailed description of the 8010M fuses is given in Section 2 of this manual. Fuse F1 can be replaced by the operator, using the procedure given in Section 2. Fuse F3 is part of the Battery Pack (Option -01) and its replacement is described in Section 6 of this manual. Fuse F2 is part of the overload protection circuit for the current measurement function. Use the following procedure to replace F2:

1. Complete the calibration access procedure given earlier in this section.

2. Refer to Figure 4-2 and identify the location of F2.

3. Remove and replace F2 with a type BBS 3A fuse.

4. Reassemble the instrument.

4-19. PERFORMANCE TESTS

4-20. The performance test is used to compare the performance of your instrument with the list of specifications given in Section 1. The performance test is recommended for incoming inspection, a preventative maintenance check, and to verify specifications. If the instrument fails any part of the performance test, calibration adjustment and/or repair is indicated.

4-21. Allow the instrument to stabilize and test it at an ambient temperature of 23 ±5°C (73 ±9°F). For the remainder of the performance test and in the calibration procedure, your instrument will be referred to as the UUT(Unit Under Test).

4-22. Display Test

4-23. Use the following procedure to test the operation of all display digits, segments, and decimal point locations:

1. On the UUT, set the POWER switch to the ON position.

2. On the UUT, select the kΩ function, 2000 kΩ range.

3. Verify that the overrange indication (1) is displayed.

4. Select the V function.

5. Verify that the LCD reads 000.

6. Connect a short between the V/kΩ and COMMON input terminals.

7. Select each range in sequence starting with the 200 mV range. Verify that the decimal point location for each range agrees with the one shown in Table 4-2.

Table 4-2. Decimal Point Location

RANGE	DISPLAY
200 mV	00.0
2V	.000
20V	0.00
200V	00.0
1000V	000

8. Remove the short from the input terminals.

9. Connect the HI output of the Multimeter Calibrator to the V/Ω input of the UUT. Connect the LO output of the Multimeter Calibrator to the COMMON input terminal of the UUT.

10. On the UUT, select the DC V function, 20V range.

11. Program the Multimeter Calibrator for an output of -18.88V. This checks each segment of every digit in the display.

4-24. Resistance Test

4-25. Use the following procedure to verify the operation and performance of the resistance ranges:

1. Connect a short between the COMMON and V/kΩ input terminals.

2. On the UUT, select the kΩ function, 200 range.

3. Verify that the display reading is 00.0 to 00.2.

4. Remove the short from the input terminals.

5. Connect the HI output of the Multimeter Calibrator to the V/kΩ input terminal of the UUT. Connect the LO output of the Multimeter Calibrator to the COMMON input terminal of the UUT.

6. Verify the accuracy of the resistance ranges by using Table 4-3 and the following procedure. For each step of Table 4-3:

a. On the UUT, select the range indicated in the Range column.

b. Program the Multimeter Calibrator for the value listed in the MC Output column.

c. Verify that the display reading on the UUT falls within the limits listed in the Display Reading column.

Table 4-3. Resistance

STEP	RANGE	MC OUTPUT	DISPLAY READING
1	200 Ω	100 Ω	99.7 to 100.3
2	2 kΩ	1 kΩ	997 to 1003
3	20 kΩ	10 kΩ	9.97 to 10.03
4	200 kΩ	100 kΩ	99.7 to 100.3
5	2000 kΩ	1 MΩ	994 to 1006
6	20 MΩ	10 MΩ	9.94 to 10.06

4-26. DC Voltage Test

4-27. Use the following procedure to verify operation and accuracy of the DC Voltage function of the UUT:

1. Connect the HI output of the Multimeter Calibrator to the V/kΩ input terminal of the UUT. Connect the LO output of the Multimeter Calibrator to the COMMON input of the UUT.

2. On the UUT, select the DC V function.

3. Refer to Table 4-4 and proceed as follows:

a. On the UUT select the range listed in the Range column.

b. Program the Multimeter Calibrator for the value listed in the MC Output column.

c. Verify that the display reading is within the limits in the Display column.

4-28. AC Voltage Test

4-29. Use the following procedure to verify the accuracy and operation of the AC Voltage function:

Table 4-4. DC Voltage Test

STEP	RANGE	MC OUTPUT	DISPLAY READING
1	20 mV	+190.0 mV	+189.7 to +190.3
2	2V	+1.900V	+1.897 to +1.903
3	20V	+19.00V	+18.97 to +19.03
4	20V	-19.00V	-18.97 to -19.03
5	200V	+190.0V	+189.7 to +190.3
6	1200V	+1000V	+998 to +1002

1. Connect the HI output of the Multimeter Calibrator to the V/kΩ input terminal of the UUT. Connect the LO output of the Multimeter Calibrator to the COMMON input terminal of the UUT.

2. On the UUT, select the AC V function.

3. Refer to Table 4-5 and proceed as follows:

a. On the UUT select the range indicated in the Range column.

b. Program the Multimeter Calibrator for the level and frequency output listed in the MC Output column.

c. Verify that the LCD display is within the values listed in the Display Reading column.

Table 4-5. AC Voltage Test

STEP	RANGE	MC OUTPUT		DISPLAY READING
		LEVEL	FREQ	
1	200 mV	190.0 mV	100 Hz	188.8 to 191.2
2	200 mV	10.0 mV	100 Hz	9.8 to 10.2
3	2V	1.900V	100 Hz	1.888 to 1.912
4	20V	19.00V	100 Hz	18.88 to 19.12
5	200V	190.0V	100 Hz	188.8 to 191.2
6	1200V	1000V	100 Hz	993 to 1007
7	1200V	1000V	10 kHz	993 to 1007
8	20V	1.00V	10 kHz	0.97 to 1.03
9	20V	19.00V	10 kHz	18.79 to 19.21
10	200V	110.0V	10 kHz	108.7 to 111.3
11	20V	19.00V	50 kHz	18.03 to 19.97

4-30. DC Current Test

4-31. Use the following procedure to verify operation and accuracy of the DC Current function:

1. Connect the HI output of the Multimeter Calibrator to the mA input terminal of the UUT. Connect the LO output of the Multimeter

Calibrator to the COMMON input terminal of the UUT.

2. On the UUT, select the DC mA function.

3. Refer to Table 4-6 and proceed as follows:

a. On the UUT, select the range listed in the Range column.

b. Program the Multimeter Calibrator for the output listed in the MC Output column.

c. Verify that the display reading is within the limits listed in the Display Reading Column.

Table 4-6. DC mA Test

STEP	RANGE	MC OUTPUT	DISPLAY READING
1	200 μA	190.0 μA	189.3 to 190.7
2	2 mA	1.900 mA	1.893 to 1.907
3	20 mA	19.00 mA	18.93 to 19.07
4	200 mA	190.0 mA	189.3 to 190.7
5	2000 mA	1900 mA	1893 to 1907

4-32. AC Current Test

4-33. Use the following procedure to verify operation and accuracy of the AC Current function:

1. Connect the HI output of the Multimeter Calibrator to the mA input terminal of the UUT. Connect the LO output of the Multimeter Calibrator to the COMMON input terminal of the UUT.

2. On the UUT, select the AC mA function, 200 μA range.

3. Program the Multimeter Calibrator for an output level of 190.0 μA at a frequency 1 kHz.

4. Verify that the display reading is within these limits: 187.9 to 192.1 μA.

4-34. CALIBRATION ADJUSTMENTS

4-35. The calibration adjustment procedures given in the following paragraphs should be performed after repair of the 8010M and/or when the unit fails the performance-test. If the unit will not respond to,or meet the limits of the adjustment procedures, troubleshooting and repair are indicated. Equipment required for the calibration adjustments is listed earlier in Table 4-1.

4-36. All calibration adjustments are accessible when the cover is removed from the 8010M. The locations of the test points and adjustments that must be accessed to complete the calibration adjustment procedures are shown in Figure 4-2.

4-37. To ensure optimum results, the calibration adjustments must be performed at an ambient temperature of 22 to 24 degrees Celsius, with a relative humidity of less than 75%. Also the unit should be allowed to warm-up for at least 1-1/2 hours before starting the adjustment procedures.

4-38. Instrument accuracies during the first 1 year after calibration are given in the instrument specification. A 1-year calibration cycle is recommended.

4-39. Initial Procedure

4-40. Complete the following procedure before attempting to make any of the calibration adjustments:

1. Remove the cover from the 8010M. See Access Procedure earlier in this section.

2. Connect the 8010M to line power and set the POWER switch to on.

3. Allow the unit to stabilize for 1-1/2 hours before proceeding with the adjustment procedures.

4-41. Adjustment Procedures

4-42. Complete the adjustment procedures in sequence. Refer to Figure 4-2 for all test point and adjustment locations. Specified inputs assume the use of the appropriate equipment listed earlier in Table 4-1.

NOTE

Since the components are on the bottom side of the pcb's, it will be necessary to turn the instrument upside down to gain access to the calibration adjustments. This inverts the display. If you have trouble reading the inverted display, there are two alternatives. First, you can stand at the side of your instrument facing the front of the instrument. Lean forward and the display will appear to be right-side-up. If this is unsatisfactory, turn the outer cover on its side with the handle perpendicular to the cover. Place a weight on the bottom leg of the handle. Connect the power cord to the power receptacle on the Main PCB and carefully slide the Main PCB about halfway into the outer case.

4-43. POWER SUPPLY CHECK

4-44. Use the following procedure to verify the power supply voltages of your instrument. If your 8010M is equipped with the Battery Pack (Option-01), use the power supply check procedure in Section 6 instead of this procedure.

1. Apply line power to the UUT. Insure that this power is at the correct voltage and frequency for your version of the instrument.

2. Place the POWER switch in the ON position.

3. On the UUT, select the DC V function, 200V range.

4. Verify that the LCD reads 00.0 ±0.1V.

5. With the DMM, check the power supply voltages listed in Table 4-7.

4-45. DC CALIBRATION ADJUSTMENT

4-46. Use the following procedure to set up the DC Voltage, DC Current, and Resistance functions:

1. On the UUT, select the DC V function, 2V range.

2. Connect the HI output terminal of the Multimeter Calibrator to the V/kΩ input terminal of the UUT using the red calibration lead. Connect the LO output terminal of the Multimeter Calibrator to the COMMON input terminal of the UUT using the black calibration lead.

3. Program the Multimeter Calibrator for a DC output of 1.888V. (This voltage is chosen so that all segments of all digits are checked.)

4. On the UUT, adjust R4 (DC CAL) for a display of exactly 1.888 on the LCD.

5. Reverse the input leads to the UUT.

6. Verify that the Display reading is between -1.887 to -1.889.

7. If necessary, adjust R4 until both readings are within 1 digit of 1.888V.

4-47. RMS CONVERTER OFFSET ADJUSTMENT

4-48. Use the following procedure to adjust the offset of the RMS Converter:

1. On the UUT, select the AC V function, any range.

2. Connect a short between the V/kΩ and COMMON terminals.

3. With the DMM, measure and record the voltage level on TP1.

4. Verify that the level is between ±20 mV.

5. Connect the DMM to TP2.

6. Adjust R7 on the RMS hybrid network so that the voltage level on TP2 is within 0.5 mV of the level recorded on TP1.

4-49. AC CALIBRATION ADJUSTMENT

4-50. The following procedure sets up the circuitry for the AC functions. There are five interacting adjustments: two potentiometers for setting low and high levels at low frequencies and three variable capacitors for setting high levels at high frequency.

1. On the UUT, select AC V, 2V range.

2. Program the Multimeter Calibrator for an output of 1.900V rms at a frequency of 100 Hz.

3. Connect the HI output of the Multimeter Calibrator to the V/kΩ input of the UUT using the red calibration lead. Connect the LO output of the Multimeter Calibrator to the COMMON input of the UUT using the black calibration lead.

4. Set R21 to the middle of its adjustment range.

5. Adjust R19 (AC HI) for a display of exactly 1.900V.

6. Program the Multimeter Calibrator for an output of 19.0 mV at 100 Hz.

7. On the UUT, select the 2V range.

8. Adjust R21 (AC LO) for a display blinking .019 to .020.

Table 4-7. Power Supply Voltages

TEST POINT	VOLTAGE FUNCTION	VOLTAGE LEVEL SHOULD READ BETWEEN:		
		FOR 115V, 60 Hz VERSION	FOR 100V, 50-60 Hz VERSION	FOR 230V, 50 Hz VERSION
TP5		-2.1 ± 0.4V	-2.1 ± 0.4V	-2.1 ± 0.4V
TP7	-VSS	-6.5 ± 1V	-4.7 ± 1V	-6.5 ± 1V
TP8	-VA	-15 ± 1V	-11 ± 1V	-15 ± 1V
TP9	+VDD	+2.9 ±0.3V	+2.9 ± 0.3V	+2.9 ± 0.3V
TP10	+VA	+15 ± 1V	+11 ± 1V	+15 ± 1V

9. The adjustments of R19 and R21 are interacting. Repeat steps 1 through 7 of this procedure until both reading requirements are met.

10. On the UUT, select a range of 20V.

11. Program the Multimeter Calibrator for an output of 19.00V at a frequency of 10 kHz.

12. Adjust C1 for a display of exactly 19.00V.

13. On the UUT, select a range of 200V.

14. Program the Multimeter Calibrator for an output of 110.0V at a frequency of 10 kHz.

15. Adjust C4 for a display of exactly 110.0V.

16. On the UUT, select AC V, 1200V range.

17. Program the Multimeter Calibrator for an output of 1000V ac (10 kHz).

18. Adjust C25 for a display of exactly 1000V.

19. Check all five of the ac calibration adjustment levels, make adjustments as necessary.

4-51. TROUBLESHOOTING

CAUTION

Static discharge can damage MOS components contained in your instrument.

4-52. When troubleshooting or repairing your meter, use the following precautions to prevent damage from static discharge:

1. Never remove, install or otherwise connect or disconnect components without first setting the POWER switch to OFF.

2. Perform all repairs at a static-free work station.

3. Do not handle IC's or pcb's by their connectors.

4. Use static ground straps to discharge repair personnel.

5. Use conductive foam to store replacement or removed IC's.

6. Remove all plastic, vinyl, and styrofoam products from the work area.

7. Use a grounded soldering iron.

4-53. A troubleshooting guide for your instrument is given in Table 4-8. To properly use the guide, complete the performance test given earlier in this section and note any discrepancies. Then locate the heading of the procedure in question in the Test and Symptom column (Table 4-8). Under that heading isolate the symptom that approximates the observed malfunction. Possible causes are listed to the right of the selected symptom. Details necessary to isolate a particular cause can be derived from the theory of operation in Section 3 and the schematic diagram in Section 8. Table 4-9 lists the test points in the instrument.

Table 4-8. Troubleshooting Guide

TEST AND SYMPTOM	POSSIBLE CAUSE
INITIAL PROCEDURE	
Display blank	Power supply, power switch, U3.
DISPLAY TEST	
One or more segments will not light through entire test.	Display interconnection, display, or A/D Converter U3.
Decade inoperative or one or more segments always lit.	U3.
Improper decimal point indication.	Range switches, U5, U6, or display. (Check signals at U6 to isolate.)
Minus sign improperly displayed.	U3.
Display lit but does not respond to changes in input.	Reference U7, crystal U1, A/D Converter U3, Touch and Hold signal line grounded, Q3, Q4.
RESISTANCE TEST	
Displayed reading is out of tolerance on at least one but not all ranges.	Range resistor U1 or R3.
Readings are noisy on all ranges.	Thermistor RT1.
Readings are out of tolerance on high ohms.	RV1, RV2, RV3 overheated from severe overload.
DC VOLTAGE TEST	
Display reading is out of tolerance on 200 mV or 2V range.	Out of calibration (DC), Vref (U7, in error, R4, U3).
Readings are out of rolerance on all ranges except 200 mV and 2V.	Range resistor U1.
AC VOLTAGE TEST	
Displayed reading is out of tolerance on 200 mV range.	Out of calibration (AC), AC converter defective.
Readings out of tolerance on all ranges except 200 mV.	Range resistor U1, C1, C4 out of calibration.
DC CURRENT TEST	
Input does not affect display.	Fuse F1, F2, CR1, U4.
Displayed reading is out of tolerance on one or more ranges.	R7, R8, R9, U2, R10.

Table 4-9. Test Points

TEST POINT	SIGNAL/CONNECTION	TEST POINT	SIGNAL/CONNECTION
TP1	RMS Converter	TP8	—VA
TP2	RMS Converter Input	TP9	+VDD
TP3	Compensation Network Input	TP10	+VA
TP4	A/D Converter HI Input	TP11	Range control input to A/D Converter
TP5	Digital Reference for A/D Converter Range	TP12	DC Reference Voltage
		TP13	Used with the -01 Option (Battery Charging Circuit)
TP6	COMMON		
TP7	-VSS	TP14	Used with the -01 Option (Battery Charging Circuit)

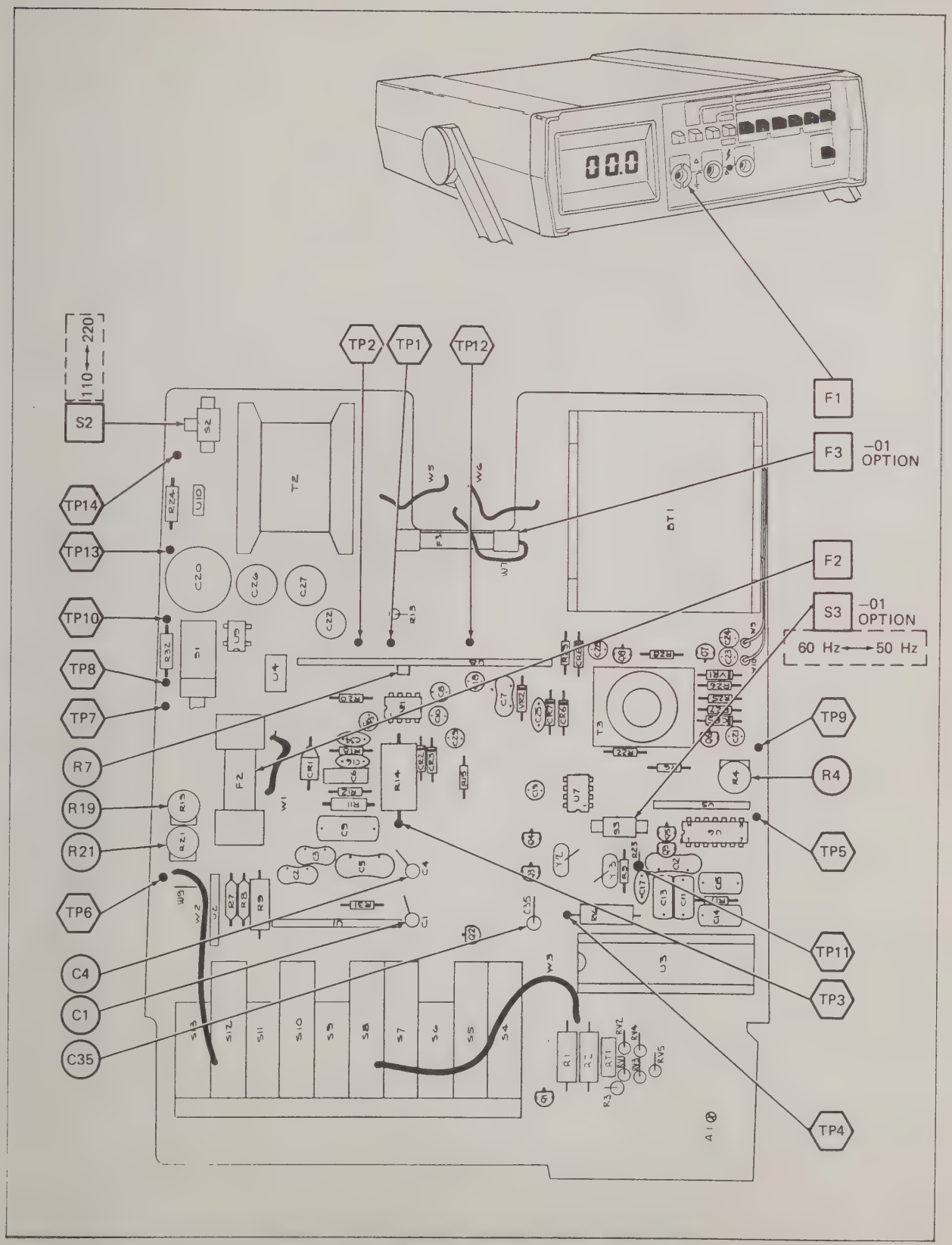


Figure 4-2. 8010M Test Point and Adjustment Locations

Section 5
List of Replaceable Parts

TABLE OF CONTENTS

ASSEMBLY NAME	TABLE NO.	PAGE	FIGURE NO.	PAGE
Final Assembly	5-1	5-3	5-1	5-4
A1 Main PCB Assembly	5-2	5-5	5-2	5-8

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. A similiar parts list is included in the Options and Accessories Section for each of the options. Components are listed alphanumerically by assembly. Both electrical and mechanical components are listed by reference designation. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

1. Reference Designation.
2. Description of Each Part.
3. FLUKE Stock Number.
4. Federal Supply Code for Manufacturers.
5. Manufacturer's Part Number.
6. Total Quantity of Components Per Assembly.
7. Recommended quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of 2 years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for 1 year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc., that are not always part of the instrument or are deviations from the basic instrument model, the REC QTY column lists the recommended spares quantity for the items in that particular assembly.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. or an authorized representative by using the FLUKE STOCK NUMBER. In the event the part ordered has been replaces by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information.

1. Quantity.
2. FLUKE Stock Number.
3. Description.
4. Reference Designation.
5. Printed Circuit Board Part Number and Revision Letter.
6. Instrument Model and Serial Number.

5-7. A Recommended Spare Parts Kit for your basic instrument is available from the factory. This kit contains those items listed in the REC QTY column for the parts lists in the quantities recommended.

5-8. Parts price information is available from the John Fluke Mfg. Co., Inc. or its representative. Prices are also available in a Fluke Replacement Parts Catalog, which is available upon request.

CAUTION

Indicated devices are subject to damage by static discharge.

Table 5-1. Final Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
	FINAL ASSEMBLY, 8010M FIGURE 5-1 (8010M-T&B)						
A1⊘	MAIN PCB ASSEMBLY (ALSO SEE OPTION -01)	ORDER	NEXT	HIGHER ASSEMBLY	1		
H1	SCREW, PHP, 6-32 X 1/2	320051	89536	320051	1		
H2	SCREW, PHP, THD. FORMING, 6-20 X 3/8	228266	89536	228266	2		
H3	WASHER, FLAT	340505	89536	340505	1		
MP1	CASE, MOLDED	478008	89536	478008	1		
MP2	DECAL, FRONT PANEL	647339	89536	647339	1		
MP3	DECAL, HANDLE, DISC	478248	89536	478248	1		
MP4	DECAL, SPECIFICATION	647347	89536	647347	1		
MP5	HANDLE, MOLDED	330092	89536	330092	1		
MP6	PAD, FOOT	338632	89536	338632	1		
MP7	TEST LEADS (NOT SHOWN)	484055	83330	363	1		
TM1	INSTRUCTION MANUAL (8010M)	649319	89536	649319			
W1	LINE CORD (NOT SHOWN)	343723	89536	343723	1	1	
	RECOMMENDED SPARE PARTS KIT (8010M)	652776	89536	652776	AR		

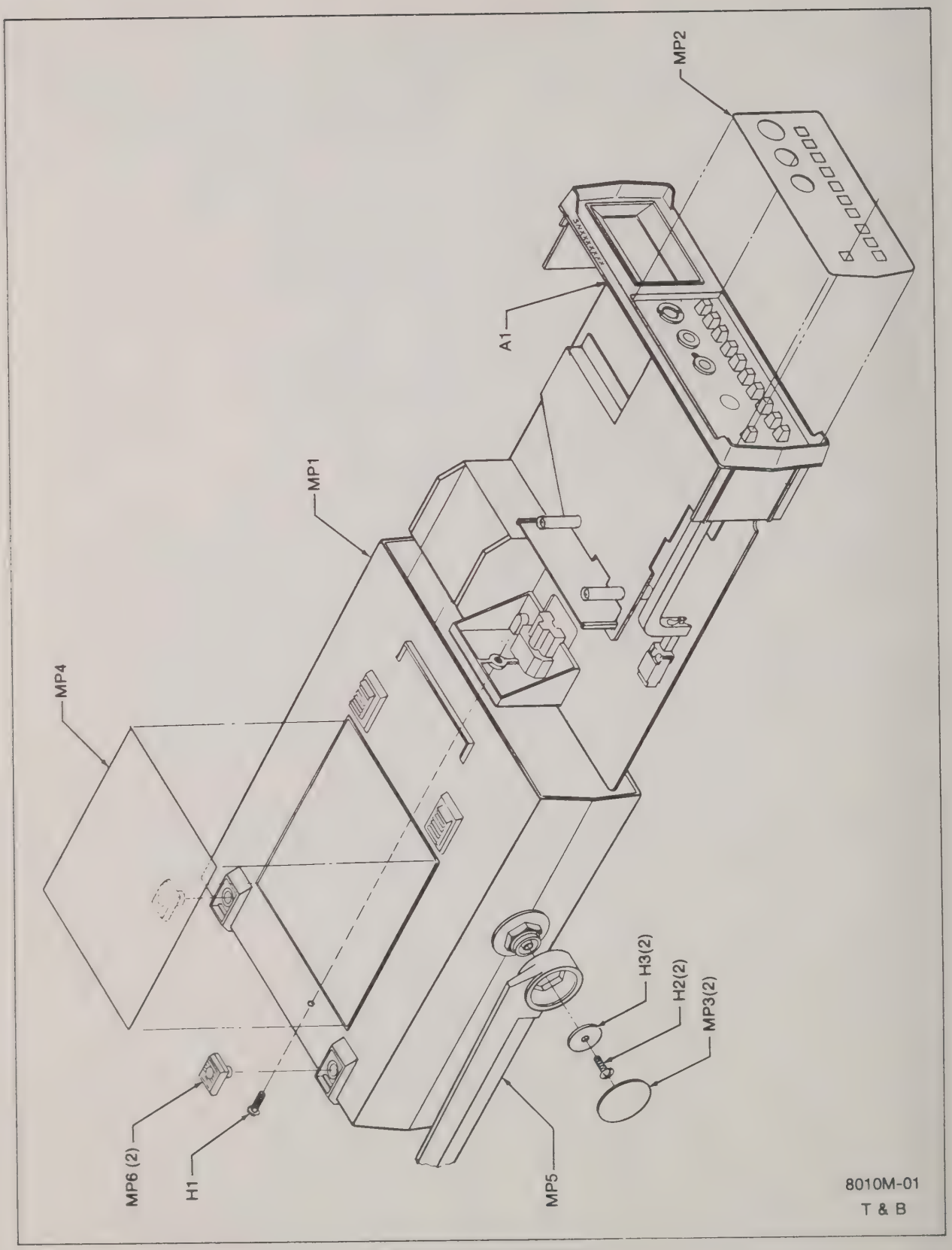


Figure 5-1. Final Assembly

Table 5-2. A1 Main PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
A1Ⓧ	MAIN PCB ASSEMBLY, 8010M FIGURE 5-2	ORDER	NEXT	HIGHER ASSEMBLY	REF		
AR1	IC, LIN OP-AMP	609891	12040	LF351N	1	1	
C1	CAP, VAR, 1.5 PF-0.25 PF, 2000V	218206	72982	530-000	3		
C2	CAP, MICA, 150 PF +/-5%, 500V	148478	72136	DM15F151J	2		
C3	CAP, MICA, 120 PF +/-5%, 500V	148486	72136	DM15F121J	1		
C4	CAP, VAR, 1.5 PF-0.25 PF, 2000V	218206	72982	530-000	REF		
C5	CAP, MICA, 3000 PF +/-5%, 500V	161786	72136	DM19F302J	REF		
C6	CAP, MYLAR, 0.047 UR +/-10%, 250V	162008	73445	C280AMAE47K	1		
C7	CAP, MICA, 150 PF +/-5%, 500V	148478	72136	DM15F151J	REF		
C8	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	4		
C9	CAP, POLY, 0.022 UF +/-10%, 1000V	448183	55112	0.022/10/1000-7	1		
C10	CAP, ELECT, 22 UF -10/+75%, 16V	436840	89536	436840	1		
C11	CAP, MYLAR, 0.047 UF +/-10%, 100V	446773	89536	446773	2		
C12	CAP, MICA, 470 PF +/-5%, 500V	148429	72136	DM19E471J	1		
C13	CAP, MYLAR, 0.047 UF +/-10%, 100V	446773	89536	446773	REF		
C14	CAP, POLY, 0.1 UF +/-10%, 2500V	446781	89536	446781	1		
C15	CAP, POLY, 0.22 UF +/-10%, 100V	436113	73445	C280MAH1A220K	1		
C16	CAP, CER, 0.01 UF +/-20%, 100V	149153	56289	C023B101F103M	2		
C17	CAP, CER, 500 PF +/-10%, 500V	105692	56289	C067B102E501K	1		
C18	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	1		
C19	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015	REF		
C30	CAP, ELECT, 220 UF +75/-10%, 16V	435990	89536	435990	3		
C31	CAP, ELECT, 220 UF +75/-10%, 16V	435990	89536	435990	REF		
C32	CAP, ELECT, 220 UF +75/-10%, 16V	435990	89536	435990	REF		
C33	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015	REF		
C34	CAP, CER, 0.01 UF +/-20%, 100V	149153	56289	C023B101F103M	REF		
C35	CAP, VAR, 1.5 PF-0.25 PF, 2000V	218206	72982	530-000	REF		
CR1	DIODE, SI, RECT. 2A, 50V	347559	05277	IN5400	1	1	
CR2	DIODE, SI, LO-CAP, LO-LEAK	348177	07263	FD7223	2	1	
CR3	DIODE, SI, LO-CAP, LO-LEAK	348177	07263	FD7223	REF		
CR9	DIODE, SI, RECT, 1A, 100V	343491	01295	1N4002	3	1	
CR10	DIODE, SI, RECT, 1A, 100V	343491	01295	1N4002	REF		
CR11	DIODE, SI, RECT, 1A, 100V	343491	01295	1N4002	REF		
F1	FUSE, FAST-BLO, 2A, 250V	376582	71400	AGX2	1	5	
F2	FUSE, FIBRE, 3A, 600V	475004	71400	BBS-3	1	5	
F3	FUSE, SLO-BLO, 1/32A	163022	71400	MDL1-32	1	5	
H1	SCREW, FHP, S/S, 4-40 X 3/8	256024	89536	256024	2		
H2	SCREW, PHP, THD. FORMING, 5-20 X 5/16	494641	89536	494641	4		
H3	SCREW, RHP, 4-40 X 1-1/8	241331	89536	241331	4		
H4	SCREW, RHP, 6-32 X 1/4	385401	89536	385401	2		
MP1	BEZEL, LCD	479642	89536	479642	1		
MP2	BRACKET, LCD	471730	89536	471730	1		
MP3	BUTTON (S4 THRU S7)	425900	89536	425900	2		
MP4	BUTTON (S8 THRU S13)	426759	89536	426759	6		
MP5	BUTTON, SWITCH, GREEN	445197	89536	445197	1		
MP6	CONNECTOR, ELASTOMERIC	453092	18565	22989	1		
MP7	CONNECTOR, PIN	376574	00779	3-87022-1	1		
MP8	INSULATOR	495044	89536	495044	1		

Table 5-2. A1 Main PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
MP9	LABEL, FIRE PROTECTION	483602	89536	483602	1		
MP10	INSULATOR, SPACER	657981	89536	657981	2		
MP11	PANEL, FRONT	651646	89536	651646	1		
MP12	PUSH ROD	479634	89536	479634	1		
MP13	RECEPTACLE, AC	471029	89536	471029	1		
MP14	SHOCK ABSORBER	428441	89536	428441	1		
MP15	SHIELD, BOTTOM	471045	89536	471045	1		
MP16	SHIELD, TOP	651695	89536	651695	1		
MP17	SPRING COMP, SS (NOT SHOWN)	422824	84830	LC-0226-3	1		
MP18	SUPPORT, HYBRID	515635	89536	515635	1		
MP19	SUPPORT, RESISTOR	545079	89536	545079	1		
MP20	GROMMET	493015	89536	493015	1		
Q1	XSTR, SI, NPN	218396	04713	2N3904	4	1	
Q2	XSTR, SI, NPN	218396	04713	2N3904	REF		
Q3	XSTR, SI, NPN	218396	04713	2N3904	REF		
Q4	XSTR, SI, PNP	195974	89536	195974	2	1	
Q5	XSTR, SI, PNP	195974	89536	195974	REF		
Q6	XSTR, SI, NPN	218396	04713	2N3904	REF		
R1	RES, COMP, 100K +/-10%, 1W	109397	01121	GB1031	1		
R2	RES, COMP, 1K +/-10%, 2W	474080	01121	HB1021	1		
R3	RES, MTL. FILM, 1K +/-0.1%, 1/8W	474445	91637	CMF551001B	1		
R4	RES, VAR, CER, 200 +/-10%, 1/2W	474973	89536	474973	1		
R5	RES, DEP. CAR, 1M +/-5%, 1/4W	348987	80031	CR251-4-5P1M	2		
R6	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	1		
R7	RES, MTL. FILM, 900 +/-0.1%, 1/8W	461988	91637	CMF55901F	1		
R8	RES, MTL. FILM, 90.0 +/-0.1%, 1/8W	461970	91637	CMF5590R0F	1		
R9	RES, WW, 9.000 +/-0.15%, 3W	461962	89536	461962	1		
R11	RES, COMP, 22M +/-10%, 1/2W	108233	01121	HB2251	2		
R12	RES, COMP, 22M +/-5%, 1/4W	221986	01121	CB2255	1		
R13	RES, DEP. CAR, 1 +/-5%, 1/4W	357665	80031	CR251-4-5P1E	1		
R14	RES, COMP, 100K +/-5%, 2W	285056	01121	HB1045	1		
R15	RES, DEP. CAR, 15 +/-5%, 1/4W	348755	80031	CR251-4-5P15E	1		
R16	RES, COMP, 1M +/-10%, 1W	109793	01121	GB1051	1		
R17	RES, DEP. CAR, 220K +/-5%, 1/4W	348953	80031	CR251-4-5P220K	1		
R18	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80034	CR251-4-5P1K	1		
R19	RES, VAR, CER, 5K +/-10%, 1/2W	478883	89536	478883	1		
R20	RES, DEP. CAR, 2.2M +/-5%, 1/4W	342659	80031	CR251-4-5P2M2	1		
R21	RES, VAR, 1M +/-10%, 1/2W	485052	89536	485052	1		
R22	RES, DEP. CAR, 470K +/-5%, 1/4W	342634	80031	CR251-4-5P470K	1		
R23	RES, DEP. CAR, 1M +/-5%, 1/4W	348987	80031	CR251-4-5P1M	REF		
R31	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100KT	1		
R32	RES, COMP, 22M +/-10%, 1/2W	108233	01121	HB2251	REF		
RT1	RES, CL, 1K +/-40%, 2W, 25 DEG C	446849	50157	180010200	1		
RV1	VARISTOR, 430V +/-10%	447672	09214	V430MA7B	5	1	
RV2	VARISTOR, 430V +/-10%	447672	09214	V430MA7B	REF		
RV3	VARISTOR, 430V +/-10%	447672	09214	V430MA7B	REF		
RV4	VARISTOR, 430V +/-10%	447672	09214	V430MA7B	REF		
RV5	VARISTOR, 430V +/-10%	447672	09214	V430MA7B	REF		
S1	SWITCH, POWER	473736	89536	473736	1		
S3	SWITCH, SLIDE	453365	34828	G1-116-0001-G20-52	REF		

Table 5-2. A1 Main PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
S4-S13	SWITCH ASSEMBLY	473322	89536	473322	1		
T1	TRANSFORMER, POWER	461509	89536	461509	1		
U1	RESISTOR NETWORK, 10.0M, 101K, 11.1K	461483	89536	461483	1	1	
U2	RESISTOR NETWORK, 0.100, 0.900	461491	89536	461491	1	1	
U3⊘	IC, C-MOS, A/D CONVERTER	429100	89536	429100	1	1	
U4	IC, FW, RECTIFIER BRIDGE, 50V-1000V, 1A	418582	83003	VM08	1	1	
U5	RESISTOR NETWORK, 25 DEG. C,+/-5%, 1/8W	474999	89536	474999	1	1	
U6⊘	IC, COS/MOS, QUAD XOR GATE	355222	89536	355222	1	1	
U7	IC,LIN,2.5V BAND-GAP REF	472845	04713	MC1403V	1	1	
U8	HYBRID RMS CONVERTER	646950	89536	646950	1	1	
U11	LIQUID CRYSTAL DISPLAY (LCD)	504324	89536	504324	1	1	
VR2	DIODE, ZENER, 4.3V	180455	07910	IN749A	1	1	
XF1	FUSE HOLDER ASSEMBLY	487967	89536	487967	1		
XF3	CLIP, FUSE	485219	91833	3529	2		
XU3	SOCKET, IC, 40-PIN	429282	09922	DILB40P-108	1		
Y2	CRYSTAL, 60 HZ, 3.840 MHZ	650408	89536	650408	1		
Y3	CRYSTAL, 50 HZ, 3.200 MHZ	650416	89536	650416	1		

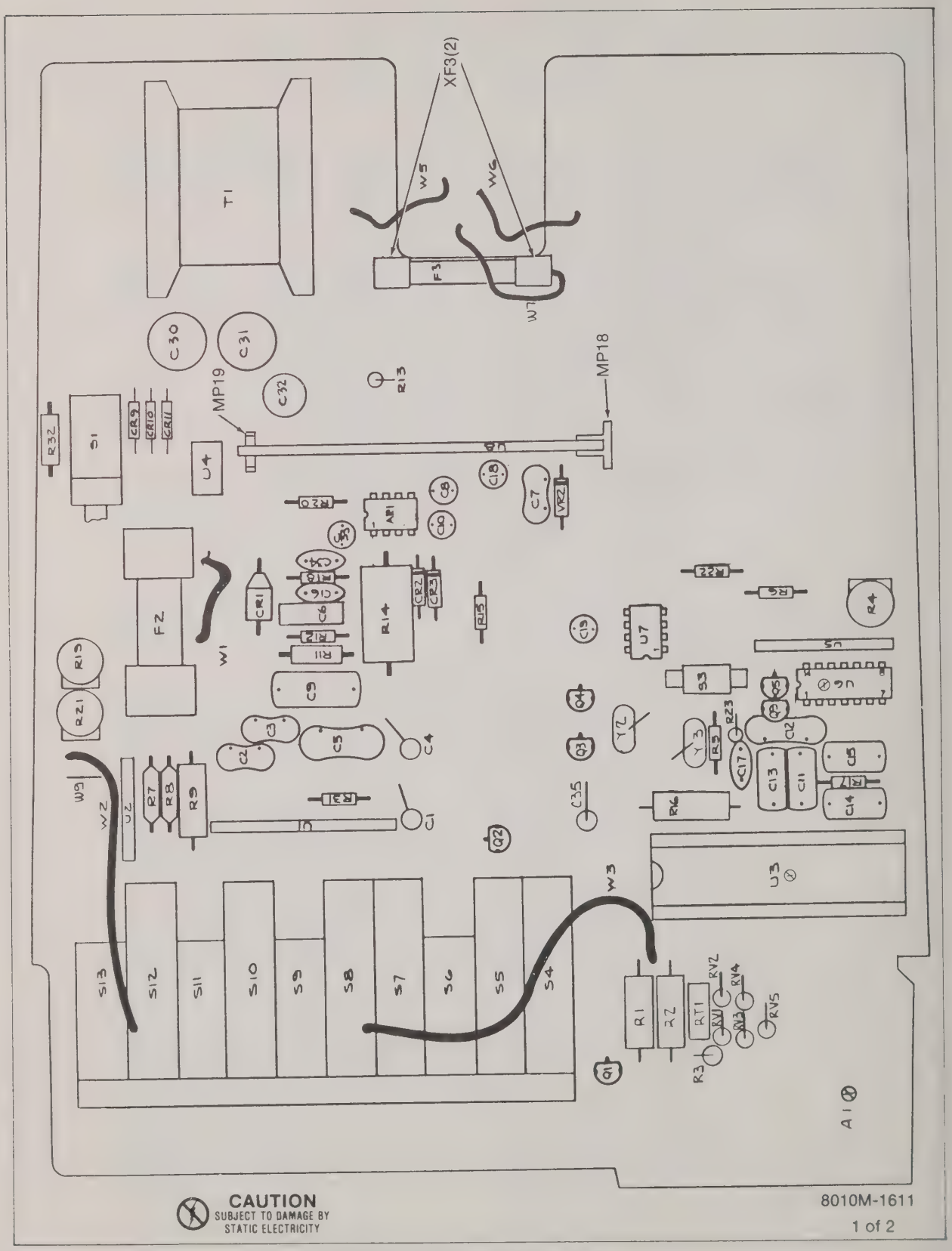


Figure 5-2. A1 Main PCB Assembly

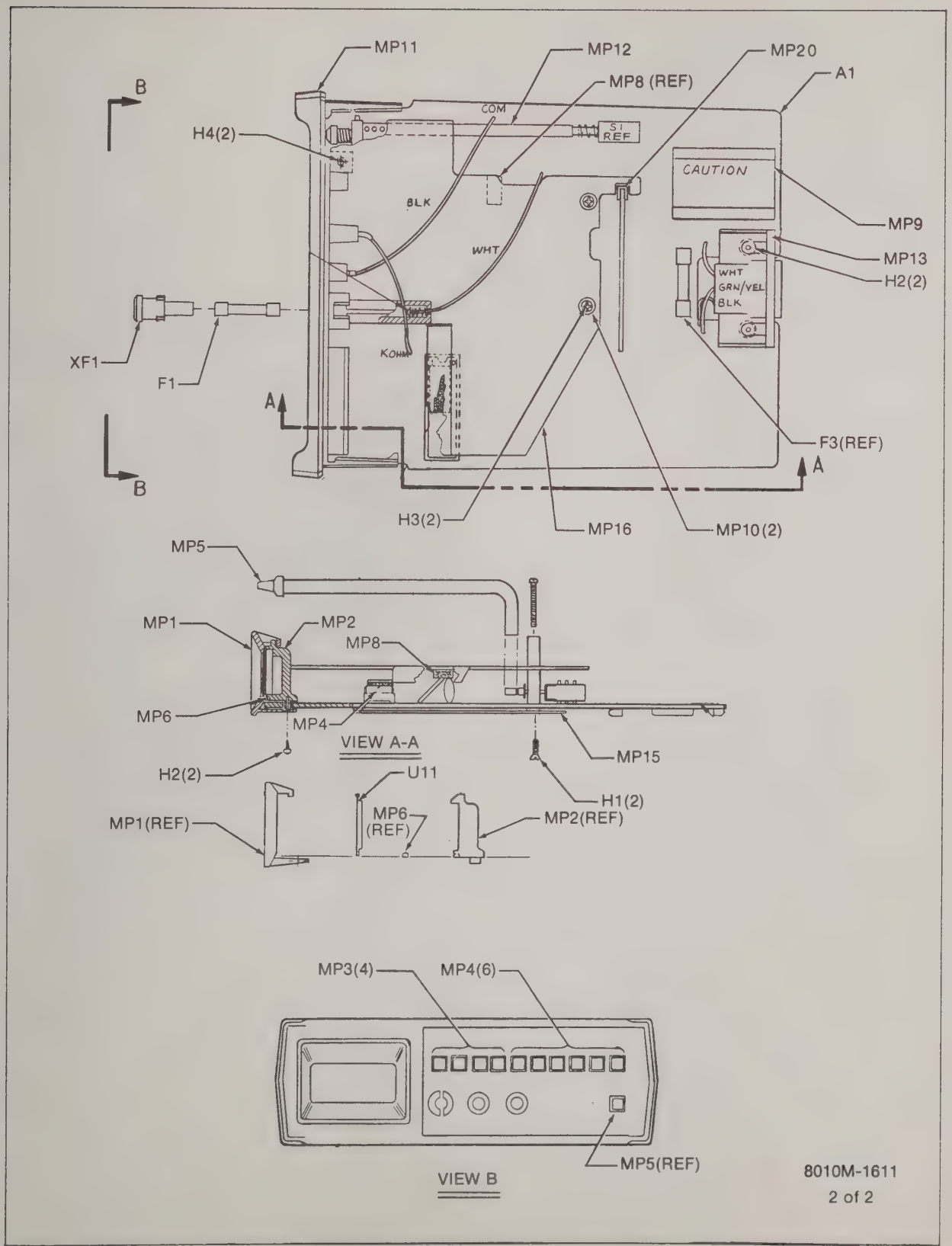


Figure 5-2. A1 Main PCB Assembly (cont)

Section 6
Option & Accessory Information

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6-1. Introduction

6-2. This section of the manual contains information concerning the options and accessories available for use with the 8010M Digital Multimeter. This information is divided into subsections. Each option documented in a subsection and all of the accessories are in one subsection. The location of an option or accessory is facilitated by the use of unique paragraph and page numbering which corresponds with the option number. For example, all the accessory pages and paragraphs are numbered 600-X but the pages and paragraphs of the -01 Option numbered 601-X. A list of replaceable parts and a component location diagram are provided with each option.

Accessories

600-1. INTRODUCTION

600-2. This section of the manual contains information concerning the accessories available for use with the Model 8010M Digital Multimeter. Each accessory is described in general terms under a separate major heading containing the accessory model number. The depth of detail is intended to give the prospective user an adequate first acquaintance with the features and capabilities of each accessory. Additional information, when necessary, is supplied with the accessory.

600-3. CARRYING CASE (Y8205)

600-4. The Model Y8205 Carrying Case, Figure 600-1, is a soft, vinyl plastic container, designed for the storage and transport of your instrument. The case provides your instrument with adequate protection against normal handling and storage conditions. A separate storage compartment is provided for test leads, power cord, and other compact accessories.

600-5. CARRYING CASE (C86)

600-6. The Model C86 Carrying Case, Figure 600-1, is a molded, polyethylene container with handle, designed for use in transporting your instrument. This rugged case provides your instrument with maximum protection against rough handling and adverse weather conditions. A separate storage compartment is provided for test leads, power cord and other compact accessories.

600-7. RACK MOUNTING KITS

600-8. Introduction

600-9. Three rack mounting kits are available for mounting your instrument in a standard 19-inch equipment rack. The kits, as shown in Figure 600-2, provide the option of offset mounting, center mounting, or side-by-side mounting.

600-10. Installation instructions for each of the rack mounting kits are given in the following paragraphs. Use the procedure which corresponds to the model number of the kit being installed.

600-11. Offset and Center Mounting Kits (M00-200-611 and M00-200-612)

600-12. Use the following procedure when installing your instrument in the standard center or offset rack mounts.

1. Remove the carrying handle by removing the handle disc decals and the handle mounting screws.

2. Remove the screw from rear of case and remove the case.

3. Install the side mounting brackets, as shown in Figure 600-3 and secure them to the mounting panel using the nuts provided.

4. Insert the front of the case through the opening on the back side of the mounting panel.

Figure 600-1. Carrying Cases

Figure 600-2. Rack Mounting Kits

5. Install the handle mounting screws through the side brackets into the handle mounting bosses. Don't over tighten these screws.

6. Slide the instrument through the mounting panel and into the case. Install and tighten the retaining screw at the rear of the case.

600-13. Side-by-Side Mounting Kit (M00-200-613)

600-14. Use the following procedure for installation of your instrument into a side mounting rack.

1. Remove the carrying handles from both instruments by removing the handle disc decals and the handle mounting screws.

2. Remove the retaining screw from the rear of the cases and separate the instruments from their cases.

3. Install the center mounting bracket, as shown in Figure 600-4 and secure it to the mounting bracket, using the nuts and washers provided.

4. Insert the front of the instrument cases through the openings on the back side of the mounting panel. Make sure the handle mounting bosses are inserted into the clamp hole of the center mounting bracket.

5. Tighten the clamp screws.

6. Install the side mounting brackets and secure them to the front panel, using the nuts provided.

7. Install the handle mounting screws through the side bracktes into the handle mounting bosses. Don't over tighten these screws.

8. Slide the instruments through the mounting panel and into their cases. Install and tighten the retaining screw at the rear of both cases.

600-15. PROBE ACCESSORIES

600-16. The following paragraphs describe the probe accessories. They are shown in Figure 600-5. When applicable, specifications for the probes are given in Table 600-1.

600-17. Safety Designed Test Lead Set (Y8131)

600-18. This test lead set is equivalent to the set originally supplied with the 8010M. The set includes one red and one black test lead. Each probe has an anti-slip shoulder near the test tip.

600-19. Deluxe Test Lead Set (Y8133)

600-20. The Y8133 is a deluxe test lead set. The attachments provided allow interconnection with a wide variety of leads and electronic components. Included in the kit are:

1. Two test leads (one red and one black). The Y8133 leads have shrouded banana connectors on each end and banana connectors on the other.

2. Two test probes

3. Two insulated alligator clips

4. Two spade lugs

5. One squeeze hook

6. One test lead pouch

7. One instruction sheet

600-21. Slim Flex Test Lead Set (Y8140)

600-22. The Y8140 Test Lead Set consists of one red and one black 60-inch (1.52 meter) test lead, each with a standard banana plug on one end and an extendable tip probe on the other end. This flexible metalic tip conductor may be extended up to 2.5 inches and is insulated to within 0.1 inch of its tip. This insulation reduces the chance of creating an inadvertent short circuit wile using the probes in their extended configuration. Intended primarily for measuring voltages, the Y8140 leads may also be used for measuring modest currents.

600-23. Touch-Hold Probe

600-24. The 80T-H is a direct signal-through test probe with a touch and hold feature. Touch-and-hold allows voltage or resistance readings to be held on a digital multimeter display following contact of the probe tip with the test point. This allows the operator to devote his full attention to manipulating the probe until the measurement is complete, then remove the probe and observe the reading on the DMM. Pressing a pushbutton on the probe causes the DMM to hold the last number displayed until the pushbutton is released.

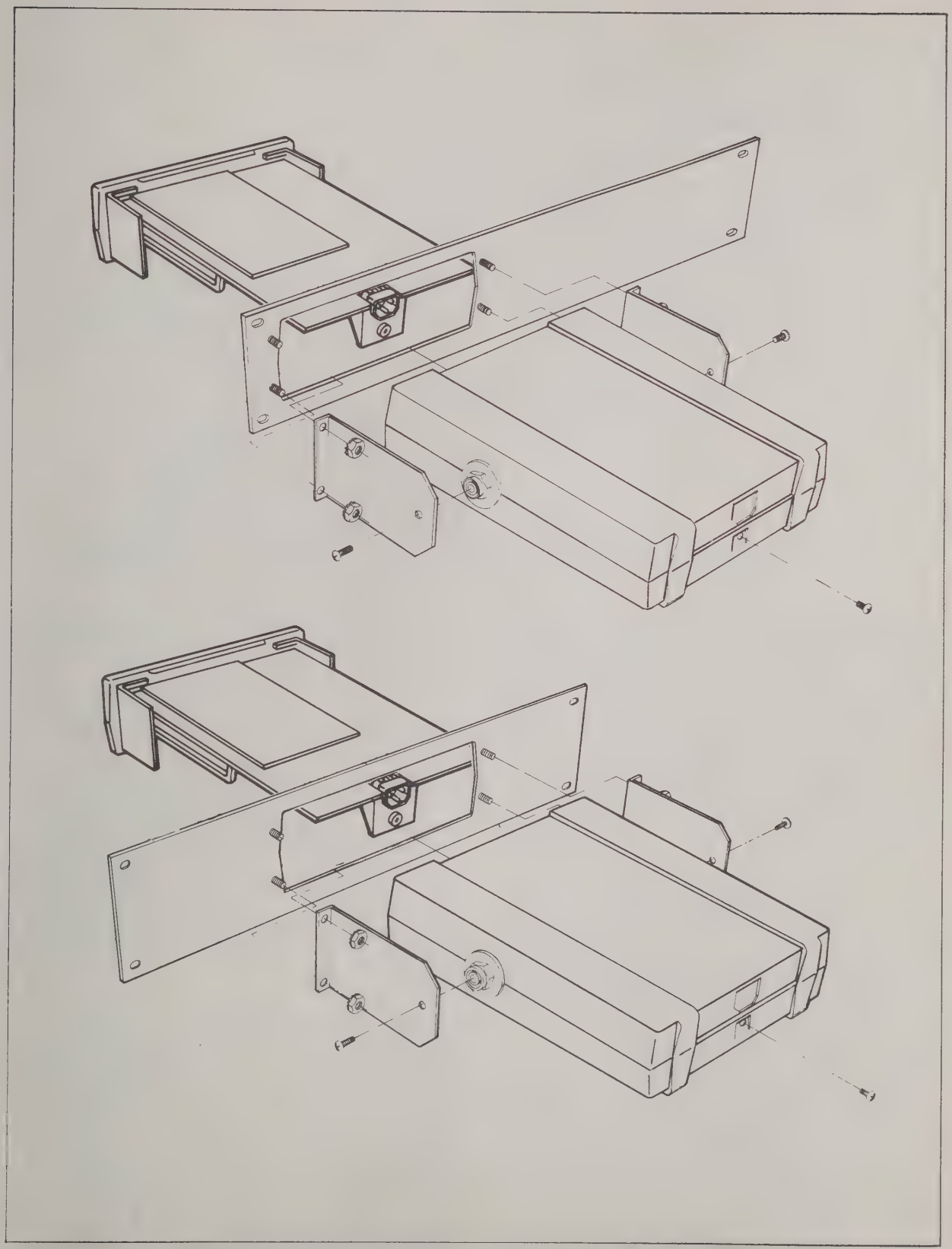

Figure 600-3. Rack Mounting Kits, Offset and Center Mounting

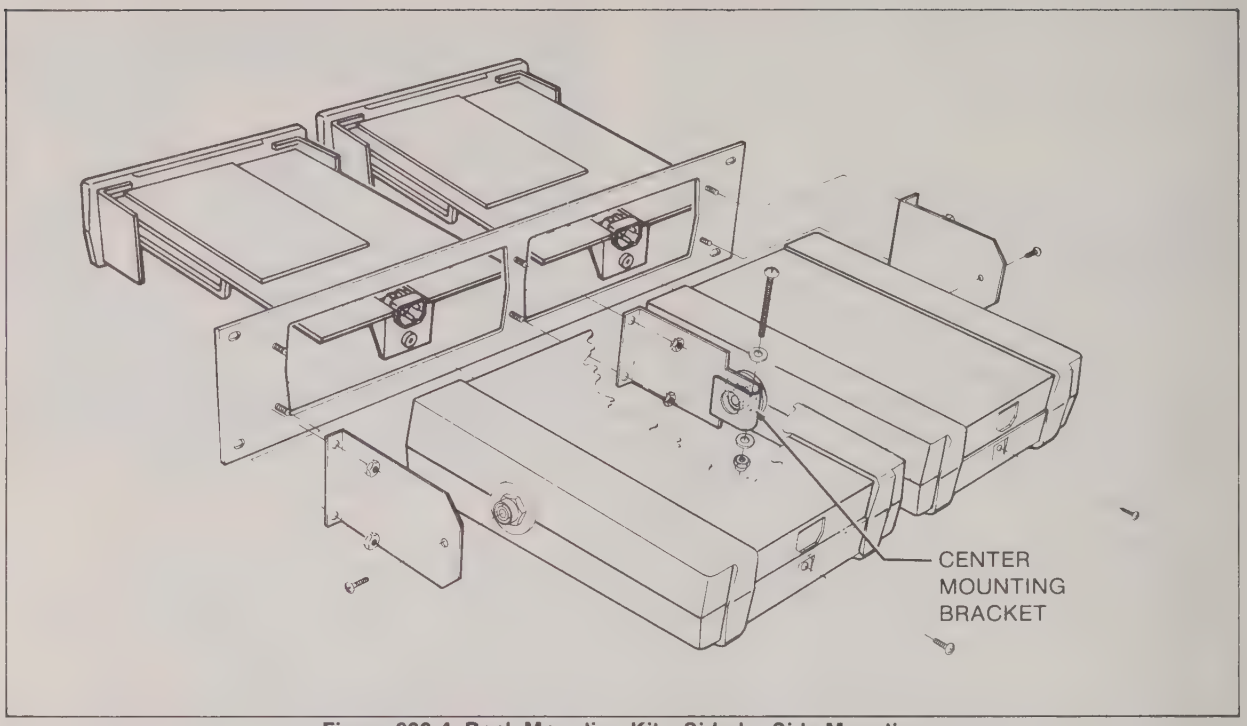

Figure 600-4. Rack Mounting Kits, Side-by-Side Mounting

600-25. Temperature Probes (80T-150C and 80T-150F)

600-26. The 80T-150 Temperature Probe converts the instrument into a direct-reading 1 mV/°C (80T-150°C) or °F(80T-150F) thermometer. It is ideally suited for surface, ambient, and liquid measurements and lends itself easily to a wide range of design, troubleshooting, and evaluating applications. A rugged, fast-responding probe-tip with a 350V dc standoff makes the 80T-150 one of the most versatile and easy-to-use temperature probes available.

600-27. High Frequency Probe (83RF)

600-28. The 83RF High Frequency Probe is designed to convert a dc voltmeter into a high frequency (100 kHz to 100 MHz) ac voltmeter. Conversion from ac to dc is accomplished on a one-to-one basis and includes a range of 0.25 to 30V rms. The probe's dc output is calibrated to be equivalent to the rms value of a sine wave input.

600-29. High Frequency Probe (85RF)

600-30. The 85RF High Frequency Probe is designed to convert a dc voltmeter into a high frequency (100 kHz to 500 MHz) ac voltmeter. Conversion from ac to dc is accomplished on a one-to-one basis and includes a range of 0.25 to 30V rms. The probe's dc output is calibrated to be equivalent to the rms vlaue of a sine wave input.

600-31. High Voltage Probe (80K-6)

600-32. The 80K-6 is a high voltage probe designed to extend the voltage measuring capability of an ac dc voltmeter to 6000 volts. A 1000:1 voltage divider provides the probe with a high input impedance. The divider also provides high accuracy when used with a voltmeter having a 10 megohm input impedance. A molded plastic body houses the divider and protects the user from the voltage being measured.

600-33. High Voltage Probe (80K-40)

600-34. The Model 80K-40 extends the voltage measurement capability of the instrument up to 40 kV. Internally, the probe contains a special 1000:1 resistive divider. Metal-film resistors with matched temperature coefficients comprise the divider and provide the probe with its excellent accuracy and stability characteristics. Also, an unusually high input impedance (1000 MΩ) minimizes circuit loading, and thereby contributes to measurement accuracy.

600-35. AC/DC Current Probe (Y8100)

600-36. The Fluke Y8100 DC/AC Current Probe is a clamp-on probe that is used with a voltmeter, multimeter, or oscilloscope to read dc, ac, or composite (ac on dc) current measurements. The jaws on the Y8100 are designed to clamp around conductors up to 3/4 inch in diameter. The pistol shape allows safe, easy, one-hand operation when making current measurements. The Model Y8100 probe is battery powered with size AA cells. It measures current to 200A dc or ac rms using most any voltmeter. Two ranges, 20A and 200A, produce a 2V output at full-range current.

600-37. AC Current Transformer (Y8101)

600-38. The Model Y8101 is a small clamp-on current transformer designed to extend the current measuring capability of an ac current meter up to 150 amperes. A clamp-on coil designed into the probe allows measurements to be made without breaking the circuit under test. This coil serves as the secondary of a 1:1000 transformer. The current-carrying conductor being measured serves as the primary.

600-39. Current Transformer (80I-600)

600-40. The Model 80I-600 extends the ac current measurement capability of the instrument up to a maximum of 600 amps. A clamp-on transformer designed into the probe allows measurements to be made without breaking the circuit under test. In use, the current carrying conductor being measured serves as the transformer's primary while the 80I-600 serves as the secondary. Because of high efficiency, quadrature-type of winding, wire size and location of the conductor within the transformer jaws do not affect accuracy of the current measurement.

600-41. Current Shunt (80J-10)

600-42. The Model 80J-10 Current Shunt extends the current measuring capability of your meter to 10 amps continuous (20 amps for periods not exceeding 1 minute) DC to 10 kHz at an accuracy of 0.25% in excess of the voltmeter accuracy.

Table 600-1. Probe Accessories Specifications

80T-H TOUCH HOLD PROBE	
Voltage Rating	
TIP TO COMMON	1000V dc or peak ac maximum
COMMON TO GROUND	60V dc or 42V peak ac maximum
Input Capacitance	150 pF maximum
Lead Resistance	0.5Ω maximum
80T-150C AND 80T-150F TEMPERATURE PROBES	
Range (°C/°F) field selectable by internal jumpers)	50°C to +150°C or -58°F to 302°F
Accuracy	±1°C (1.8°F) from 0°C to 100°C, decreasing linearly to ±3°C (5.4°F) at -50°C and +150°C
Resolution	0.1°C on 200 mV range
Voltage Standoff	350V dc or peak ac
Power	Internal disposable battery; 1.000 hours of continuous use
83RF HIGH FREQUENCY PROBE	
AC-to-DC Ratio	1:1
Ratio Accuracy (at 1 MHz and loaded with 10 MΩ)	
ABOVE 1V	±1 dB
BELOW 1V	±1.5 dB
Frequency Response (Relative to 1 MHz)	100 kHz to 100 MHz ± 1 dB
Extended Frequency Response	Useful for relative readings from 20 kHz to 250 MHz
Response	Responds to the peak value of an input and is calibrated to read rms value of a sine wave
Voltage Range	0.25 to 30V rms
Maximum Input Voltage	30V rms, 200V dc
Input Capacitance	Approximately 3 pF
Temperature Range	
OPERATING	+10°C to +35°C
STORAGE	-40°C to +75°C
Humidity	<90% R.H.
Output Connector	Fits standard 0.75-inch dual banana connectors
Accessory	BNC to Probe Adapter, P/N 574756

Table 600-1. Probe Accessories Specifications (cont)

85RF HIGH FREQUENCY PROBE	
AC-to-DC Ratio	1:1
Ratio Accuracy (At 1 MHz and loaded with 10 MΩ)	
ABOVE 0.5V	±0.5 dB
BELOW 0.5V	±1.0 dB
Frequency Response (Relative to 1 MHz)	100 kHz to 100 MHz ±.5 dB *100 MHz to 200 MHz ±1.0 dB *200 MHz to 500 MHz ±3.0 dB *Referred to high and low inputs at probe tip.
Extended Frequency Response	Useful for relative readings from 20 kHz to 700 MHz
Response	Responds to the peak value of an input and is calibrated to read rms value of a sine wave
Voltage Range	0.25 to 30V rms
Maximum Input Voltage	30V rms, 200V dc
Input Capacitance	Approximately 3 pF
Temperature Range	
OPERATING	+10°C to +35°C
STORAGE	-40°C to +75°C
Humidity	<90% R.H.
Output Connector	Fits standard 0.75-inch dual banana connectors
Accessory	BNC to Probe Adapter, P/N 574756
80K-6 HIGH VOLTAGE PROBE	
Voltage Range	0 to 6 kV, dc or peak ac
Input Impedance	75 megohms nominal
Division Ratio	1000:1
Accuracy	
DC TO 500 HZ	±1%
500 HZ TO 1 KHZ	±2%
ABOVE 1 KHZ	Output reading falls. Typically, 30% at 10 kHz.
80K-40 HIGH VOLTAGE PROBE	
Voltage Range	1 kV to 40 kV dc or peak ac, 28 kV rms ac
Input Resistance	1000 MΩ
Division Ratio	1000:1
Accuracy Dc (overall)	20 kV to 30 kV ±2% (calibrated at 25 kV)
UPPER LIMIT	Changes linearly from 2% at 30 kV to 4% at 40 kV
LOWER LIMIT	Changes linearly from 2% at 20 kV to 4% at 1 kV
Accuracy Ac (Overall)	±5% at 60 Hz
Y8100 DC/AC CURRENT PROBE	
Ranges	20A ac or dc 200A ac or dc
Rated Output	2V at full range
Accuracy	
DC TO 200 HZ	±2% of range
200 HZ TO 1 KHZ	<100A add ±3% reading >100A add ±6% reading
Calibration Cycle	1 year
Frequency Response	dc to 1.0 kHz
Recommended Load	≥3.0 kΩ
Temperature Range	+15°C to +35°C; for specified accuracy -10°C to +50°C, storage and operation at reduced accuracy.

Table 600-1. Probe Accessories Specifications (cont)

Heating Limitation	Prolonged operation above 200A ac or 1 kHz can cause damage to the Y8100.
Working Voltage Rating	Core to output; 600V dc or 480V ac maximum output to ground; 42V dc or 30V ac
Aperture Size	3/4" (19 mm) diameter
Size-Overall	9"x4-1/2"x1-7/16" (230 mm x 115 x 37 mm)
Weight	14 ounces (0.4 kg), with batteries
Power	Four "AA" cells
Battery Life	Alkaline-20 hours continuous

Y8101 AC CURRENT TRANSFORMER

Current Range	2A to 150A
ACCURACY, (48 Hz to 10 kHz)	±2%, 10A to 150A ±8%, 2A to 10A
Division Ratio	1000:1
Working Voltage	300V ac rms maximum
Insulation Dielectric Withstand Voltage	3 kV rms
Maximum conductor Size	7/16" (1.11 cm)

80I-600 CURRENT TRANSFORMER

Range	1 to 600A ac
Accuracy	±3%
Frequency Response	30 Hz to 1 kHz, 10 kHz typical
Division Ratio	1000:1
Working Voltage	750V rms maximum
Insulation Dielectric Withstand Voltage	5 kV
Maximum Conductor Size	2-inch diameter

80J-10 CURRENT SHUNT

Shunt	10 amps at 100 mV
Accuracy (18°C to 28°C)	
DC TO 10 KHZ	±0.25%
10 KHZ-100 KHZ	Rising to 1 dB at 100 kHz typical
Temperature Coefficient	0.005%/°C
Inductance	8.3 nH in series w/0.01Ω shunt
Overload	Up to one minute at 20A with a 1/4 duty cycle for recovery after currents between 10A and 20A
Connects to	3/4 inch center banana jacks
Connectors	5-way binding posts (red and black)

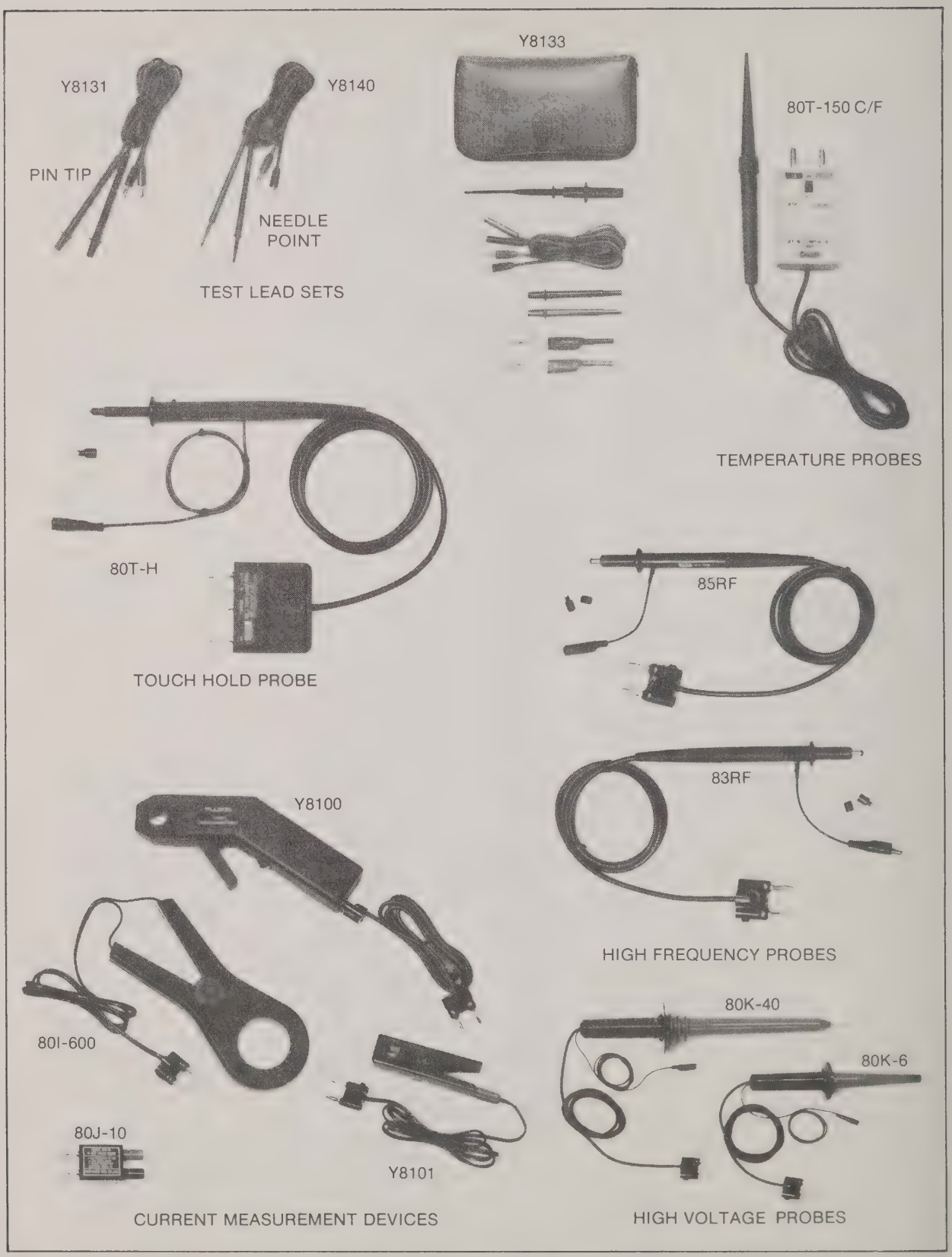

Figure 600-5. Probe Accessories

Option -01
Battery Pack/Selectable Line Frequency Rejection

601-1. INTRODUCTION

601-2. The Battery Pack (Option -01) allows the 8010M to be operated from line power or a rechargeable battery pack. The option also allows switch selection of the internal clock frequency to optimize noise rejection at either 50 Hz or 60 Hz. Typically, the 8010M will operate for 15 hours on a fully charged set of batteries.

601-3. SPECIFICATIONS

601-4. Specifications for the Battery Pack/Selectable Line Frequency Rejection feature (Option -01) are as follows:

REJECTION FREQUENCIES	50 Hz, 60 Hz or multiples thereof.
BATTERY	
Type	Two rechargeable, Size-C Ni-cad cells.
Operating Time	15 to 30 hours depending upon functions used.
Recharge Time	Approxiately 14 hours with the POWER switch in the OFF position.
Low Indicator	The letters "BT" are presented on the front panel display when approximately one-half hour of operation remains.

601-5. OPERATION

601-6. The operating instructions given in Section 2 of this manual apply directly to an 8010M equipped with Option -01. Instructions that are unique to Option -01. are described in the following paragraphs.

601-7. Recharging the Batteries

601-8. To recharge the batteries, connect the 8010M to line power and set the POWER switch to the OFF position. The full charge time for a discharged set of batteries is about 14 hours. If the POWER switch is left in the ON position, the instrument will operate properly and the batteries will maintain their current charge level. However, the batteries will not charge to a higher level.

601-9. Line Frequency Rejection

WARNING

TO AVOID ELECTRICAL SHOCK HAZARDS, DO NOT ATTEMPT TO CHANGE THE LINE FREQUENCY REJECTION SWITCH SETTING UNLESS YOU ARE A QUALIFIED TECHNICIAN.

601-10. Line frequency noise rejection is switch selectable for either 50 Hz or 60 Hz. The frequency selected when the instrument left the factory is marked on the decal on the bottom of the instrument. If the rejection frequency must be changed, refer to the job to a qualified technician. The selection procedure is given later in this subsection under Maintenance.

601-11. THEORY OF OPERATION

601-12. The theory of operation will be illustrated by the Main PCB schematic in Section 8.

601-13. The battery power supply is shown on the schematic in the lower left hand corner just above the standard power supply schematic. The Option -01 power supply can be used with line voltages of 90V to 264V, 50 Hz or 60 Hz. Selector switch S2 should be positioned for high or low voltage depending upon the line voltage being used. F3 provides fuse protection for the power supply. Line power input is rectified, filtered and regulated. The output of the power supply acts as a current source for the battery. The battery determines the voltage level into the low power oscillator. Don't operate your instrument with the battery removed. The low power oscillator uses the

fly-back transformer technique to boost the output voltage, +VDD-(-VSS) to 10V. This in turn is converted to a +VA and -VA of ±11.5V.

601-14. When the battery voltage drops below 2.1V, the BT indicator will appear on the display. (This BT indicator will also appear briefly when the instrument is turned off). After the BT indicator appears you have at least 1/2 hour before the accuracy of the instrument will be affected.

NOTE

The AC functions consume a lot more power than the other functions. The battery charge may be too low for AC functions (BT displayed) and still be adequate for proper operation with other functions (BT not displayed).

601-15. The selectable line frequency rejection circuit is connected to pins 39 and 40 of the custom IC. This circuit replaces Y1. It consists of two crystals and a switch. The switch selects either the 50 Hz crystal or the 60 Hz crystal for the clock frequency reference.

601-16. MAINTENANCE

601-17. Battery Replacement

601-18. Use the following procedure for removing and replacing batteries:

1. Disconnect the line cord. Remove the retaining screw at the rear of the instrument case, and remove the instrument from the case.

2. Turn the instrument upside down.

3. Unplug the red and black battery wires.

4. Apply pressure to the sides of the battery case to disconnect the battery case from the Main PCB.

5. Remove the blotting paper.

6. Replace the batteries with a new Fluke battery assembly.

7. Replace the blotting paper and connect the battery case back to the Main PCB.

8. Connect the battery wires to their appropriate connector on the Main PCB, red to +, black to -.

9. Replace the instrument in its case.

601-19. Fuse Replacement

601-20. Use the following procedure to replace the main power fuse, F3.

1. Perform the Calibration Access Procedure in Section 4.

2. F3 is located immediately in front of the power receptacle. See Figure 4-2.

3. Replace F3 with a 1/32A, Slo-Blo, 250V fuse.

601-21. Selecting Line Frequency Rejection

601-22. Use the following procedure to select line frequency rejection, 50 Hz or 60 Hz or multiples thereof.

1. Perform the Calibration Access Procedure given in Section 4.

2. Locate Switch S3 as shown in Figure 4-2.

3. Determine the line frequency of the local operating environment and set S3 to that frequency setting or to the setting that is a multiple of the line frequency. (See Figure 4-2.) For example, for a 400 Hz line frequency, set S3 to the 50 Hz position.

601-23. Selecting Line Voltage

601-24. Use the following procedure to select the desired voltage range:

1. Perform the Calibration Access Procedure given in Section 4.

2. Locate the line voltage selection switch S2 as shown in Figure 4-2.

3. Determine the voltage of the local ac power line and set switch S2 to the appropriate position (see Figure 4-2).

601-25. Power Supply Check

601-26. Use the following procedure to verify the power supply voltages of your instrument:

1. Place the POWER switch on the UUT to the ON position.

2. On the UUT, select the DC V function, 200V range.

3. Verify that the LCD displays 00.0 ±0.1V.

4. With the DMM, verify that the power supply voltages are within the limits given in Table 601-1.

601-27. REPLACEABLE PARTS

601-28. Table 601-2 is a list of replaceable parts for the Option -01. Refer to Section 5 of this manual for ordering information.

Table 601-1. -01 Option Power Supply Voltages

TEST POINT	VOLTAGE FUNCTION	VOLTAGE LEVELS DURING BATTERY OPERATION	REMARKS
TP5 TP7 TP9	 -VSS +VDD	-2.1 ± 0.4V -6.5 ± 1V +2.9 ± 0.3V	
TP8 TP10	-VA +VA	-11.5 ± 1V +11.5 ± 1V	An ac function must be selected to measure -VA and +VA.
TP13 (+) to TP9 TP14 (+) to TP13		+2.4V nominal +1.25 ± 0.05V	Variable, 2.0 to 3.0V, depending upon battery charge level. Determines battery charging current through R24.

Table 601-2. A1 Main PCB Assembly (-01 Option)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
A1 Ⓟ	MAIN PCB ASSEMBLY, 8010M-01 OPTION FIGURE 601-1 (8010M-4011)	ORDER	NEXT	HIGHER ASSEMBLY	REF		
AR1	IC, LIN OP-AMP	609891	12040	LF351N	1	1	
BT1	BATTERY ASSY	487975	89536	487975	1		
C1	CAP, VAR, 1.5 PF-0.25 PF, 2000V	218206	72982	530-000	3		
C2	CAP, MICA, 150 PF +/-5%, 500V	148478	72136	DM15F151J	2		
C3	CAP, MICA, 120 PF +/-5%, 500V	148486	72136	DM15F121J	1		
C4	CAP, VAR, 1.5 PF-0.25 PF, 2000V	218206	72982	530-000	REF		
C5	CAP, MICA, 3000 PF +/-5%, 500V	161786	72136	DM19F302J	REF		
C6	CAP, MYLAR, 0.047 UR +/-10%, 250V	162008	73445	C280AMAE47K	1		
C7	CAP, MICA, 150 PF +/-5%, 500V	148478	72136	DM15F151J	REF		
C8	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	4		
C9	CAP, POLY, 0.022 UF +/-10%, 1000V	448183	55112	0.022/10/1000-7	1		
C10	CAP, ELECT, 22 UF -10/+75%, 16V	436840	89536	436840	3		
C11	CAP, MYLAR, 0.047 UF +/-10%, 100V	446773	89536	446773	2		
C12	CAP, MICA, 470 PF +/-5%, 500V	148429	72136	DM19E471J	1		
C13	CAP, MYLAR, 0.047 UF +/-10%, 100V	446773	89536	446773	REF		
C14	CAP, POLY, 0.1 UF +/-10%, 2500V	446781	89536	446781	1		
C15	CAP, POLY, 0.22 UF +/-10%, 100V	436113	73445	C280MAH1A220K	1		
C16	CAP, CER, 0.01 UF +/-20%, 100V	149153	56289	C023B101F103M	2		
C17	CAP, CER, 500 PF +/-10%, 500V	105692	56289	C067B102E501K	1		
C18	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	3		
C19	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015	REF		
C20	CAP, ELECT, 2200 UF +75/-10%, 16V	474981	89536	474981	1		
C21	CAP, ELECT, 22 UF +75/-10%, 16V	436840	89536	436840	REF		
C22	CAP, ELECT, 220 UF +75/10%, 16V	435990	89536	435990	3		
C23	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C24	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C25	CAP, CER, 1000 PF +/-10%, 500V	357806	56289	C016B102G102K	1		
C26	CAP, ELECT, 220 UF +75/10%, 16V	435990	89536	435990	REF		
C27	CAP, ELECT, 220 UF +75/-10%, 16V	435990	89536	435990	REF		
C28	CAP, ELECT, 22 UF -10/+75%, 16V	436840	89536	436840	REF		
C29	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	1		
C33	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015	REF		
C34	CAP, CER, 0.01 UF +/-20%, 100V	149153	56289	C023B101F103M	REF		
C35	CAP, VAR, 1.5 PF-0.25 PF, 2000V	218206	72982	530-000	REF		
CR1	DIODE, SI, RECT. 2A, 50V	347559	05277	IN5400	1	1	
CR2	DIODE, SI, LO-CAP, LO-LEAK	348177	07263	FD7223	2	1	
CR3	DIODE, SI, LO-CAP, LO-LEAK	348177	07263	FD7223	REF		
CR5	DIODE, HI-SPEED SWITCH	203323	07910	1N4448	2	1	
CR6	DIODE, SI, RECT, 1A	343491	01295	1N4002	2	1	
CR7	DIODE, SI, RECT, 1A	343491	01295	1N4002	REF		
CR8	DIODE, HI-SPEED SWITCH	203323	07910	1N4448	REF		
F1	FUSE, FAST-BLO, 2A, 250V	376582	71400	AGX2	1	5	
F2	FUSE, FIBRE, 3A, 600V	475004	71400	BBS-3	1	5	
F3	FUSE, SLO-BLO, 1/32A	163022	71400	MDL1-32	1	5	
H1	SCREW, FHP, S/S, 4-40 X 3/8	256024	89536	256024	2		
H2	SCREW, PHP, THD. FORMING, 5-20 X 5/16	494641	89536	494641	4		
H3	SCREW, RHP, 4-40 X 1-1/8	241331	89536	241331	2		

Table 601-2. A1 Main PCB Assembly (-01 Option) (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
H4	SCREW, RHP, 6-32 X 1/4	385401	89536	385401	2		
MP1	BEZEL, LCD	479642	89536	479642	1		
MP2	BRACKET, LCD	471730	89536	471730	1		
MP3	BUTTON (S4 THRU S7)	425900	89536	425900	4		
MP4	BUTTON (S8 THRU S13)	426759	89536	426759	6		
MP5	BUTTON, SWITCH, GREEN	445197	89536	445197	1		
MP6	CONNECTOR, ELASTOMERIC	453092	18565	22989	1		
MP7	CONNECTOR, PIN	376574	00779	3-87022-1	2		
MP8	HEAT SINK	650309	13103	6043PB	1		
MP9	INSULATOR	495044	89536	495044	1		
MP10	LABEL, FIRE PROTECTION	483602	89536	483602	1		
MP11	PAD, ABSORBENT	483610	89536	483610	1		
MP12	PANEL, FRONT	651646	89536	651646	1		
MP13	PUSH ROD	479634	89536	479634	1		
MP14	RECEPTACLE, AC	471029	89536	471029	1		
MP15	RETAINER, BATTERY	471052	89536	471052	1		
MP16	SHIELD, BOTTOM	471045	89536	471045	1		
MP17	SHIELD, TOP	651695	89536	651695	1		
MP18	SPRING COMP, SS (NOT SHOWN)	422824	84830	LC-0226-3	1		
MP19	SUPPORT, HYBRID	515635	89536	515635	1		
MP20	SUPPORT, RESISTOR	545079	89536	545079	1		
MP21	SHOCK ABSORBER	428441	89536	428441	1		
MP22	INSULATOR, SPACER	657981	89536	657981	2		
MP23	GROMMET	493015	89536	493015	1		
Q1	XSTR, SI, NPN	218396	89536	218396	4	1	
Q2	XSTR, SI, NPN	218396	89536	218396	REF		
Q3	XSTR, SI, NPN	218396	89536	218396	REF		
Q4	XSTR, SI, PNP	195974	89536	195974	2	1	
Q5	XSTR, SI, PNP	195974	89536	195974	REF		
Q6	XSTR, SI, PNP	523647	04713	MPS6651	1	1	
Q7	XSTR, SI, NPN	168716	89536	168716	1	1	
Q8	XSTR, SI, PNP	195974	89536	195974	1	1	
Q9	XSTR, SI, NPN	218396	89536	218396	REF		
R1	RES, COMP, 100K +/-10%, 1W	109397	01121	GB1031	1		
R2	RES, COMP, 1K +/-10%, 2W	474080	01121	HB1021	1		
R3	RES, MTL. FILM, 1K +/-0.1%, 1/8W	474445	91637	CMF551001B	1		
R4	RES, VAR, CER, 200 +/-10%, 1/2W	474973	89536	474973	1		
R5	RES, DEP. CAR, 1M +/-5%, 1/4W	348987	80031	CR251-4-5P1M	2		
R6	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	1		
R7	RES, MTL. FILM, 900 +/-0.1%, 1/8W	461988	91637	CMF55901F	1		
R8	RES, MTL. FILM, 90.0 +/-0.1%, 1/8W	461970	91637	CMF5590R0F	1		
R9	RES, WW, 9.000 +/-0.15%, 3W	461962	89536	461962	1		
R11	RES, COMP, 22M +/-10%, 1/2W	108233	01121	HB2251	2		
R12	RES, COMP, 22M +/-5%, 1/4W	221986	01121	CB2255	1		
R13	RES, DEP. CAR, 1 +/-5%, 1/4W	357665	80031	CR251-4-5P1E	1		
R14	RES, COMP, 100K +/-5%, 2W	285056	01121	HB1045	1		
R15	RES, DEP. CAR, 15 +/-5%, 1/4W	348755	80031	CR251-4-5P15E	1		
R16	RES, COMP, 1M +/-10%, 1W	109793	01121	GB1051	1		
R17	RES, DEP. CAR, 220K +/-5%, 1/4W	348953	80031	CR251-4-5P220K	1		
R18	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80034	CR251-4-5P1K	1		

Table 601-2. A1 Main PCB Assembly (-01 Option) (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO.	TOT QTY	REC QTY	NOTE
R19	RES, VAR, CER, 5K +/-10%, 1/2W	478883	89536	478883	1		
R20	RES, DEP. CAR, 2.2M +/-5%, 1/4W	342659	80031	CR251-4-5P2M2	1		
R21	RES, VAR, 1M +/-10%, 1/2W	485052	89536	485052	1		
R22	RES, DEP. CAR, 470K +/-5%, 1/4W	342634	80031	CR251-4-5P470K	1		
R23	RES, DEP. CAR, 1M +/-5%, 1/4W	348987	80031	CR251-4-5P1M	REF		
R24	RES, COMP, 8.2 +/-5%, 1/2W	159590	01121	EB8G25	1		
R25	RES, DEP. CAR, 3.3K +/-5%, 1/4W	348813	80031	CR251-4-5P3K3	1		
R26	RES, DEP. CAR, 47 +/-5%, 1/4W	441592	80031	CR251-4-5P47E	1		
R27	RES, DEP. CAR, 1 +/-5%, 1/4W	357665	80031	CR251-4-5P1E	1		
R28	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	1		
R29	RES, DEP. CAR, 4.7K +/-5%, 1/4W	348821	80031	CR251-4-5P4K7	1		
R31	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100KT	1		
R32	RES, COMP, 22M +/-10%, 1/2W	108233	01121	HB2251	REF		
RT1	RES, CL, 1K +/-40%, 2W, 25 DEG C	446849	50157	180010200	1		
RV1	VARISTOR, 430V +/-10%	447672	09214	V430MA7B	5	1	
RV2	VARISTOR, 430V +/-10%	447672	09214	V430MA7B	REF		
RV3	VARISTOR, 430V +/-10%	447672	09214	V430MA7B	REF		
RV4	VARISTOR, 430V +/-10%	447672	09214	V430MA7B	REF		
RV5	VARISTOR, 430V +/-10%	447672	09214	V430MA7B	REF		
S1	SWITCH, POWER	473736	89536	473736	1		
S2	SWITCH, SLIDE	453365	34828	G1-116-0001-G20-52	2	1	
S3	SWITCH, SLIDE	453365	34828	G1-116-0001-G20-52	REF		
S4-S13	SWITCH ASSEMBLY	473322	89536	473322	1		
T2	TRANSFORMER, POWER	490110	89536	490110	1		
T3	TRANSFORMER, DC-DC CONVERTER	478453	89536	478453	1		
U1	RESISTOR NETWORK, 10.0M, 101K, 11.1K	461483	89536	461483	1	1	
U2	RESISTOR NETWORK, 0.100, 0.900	461491	89536	461491	1	1	
U3⊘	IC, C-MOS, A/D CONVERTER	429100	89536	429100	1	1	
U4	IC, FW, RECTIFIER BRIDGE, 50V-1000V, 1A	418582	83003	VM08	2	1	
U5	RESISTOR NETWORK, 25 DEG. C,+/-5%, 1/8W	474999	89536	474999	1	1	
U6⊘	IC, COS/MOS, QUAD XOR GATE	355222	89536	355222	1	1	
U7	IC,LIN,2.5V BAND-GAP REF	472845	04713	MC1403V	1	1	
U8	HYBRID RMS CONVERTER	646950	89536	646950	1	1	
U9	IC, FW, RECTIFIER BRIDGE, 50V-1000V, 1A	418582	83003	VM08	REF		
U10	IC, LIN VOLTAGE REGULATOR	460410	12040	LM317T	1	1	
U11	LIQUID CRYSTAL DISPLAY (LCD)	504324	89536	504324	1	1	
VR1	DIODE, ZENER	473744	07910	1N5240	1	1	
VR2	DIODE, ZENER, 4.3V	180455	07910	IN749A	1	1	
XF1	FUSE HOLDER ASSEMBLY	487967	89536	487967	1		
XF3	CLIP, FUSE	485219	91833	3529	2		
XU3	SOCKET, IC, 40-PIN	429282	09922	DILB40P-108	1		
Y2	CRYSTAL, 60 HZ, 3.840 MHZ	650408	89536	650408	1		
Y3	CRYSTAL, 50 HZ, 3.200 MHZ	650416	89536	650416	1		

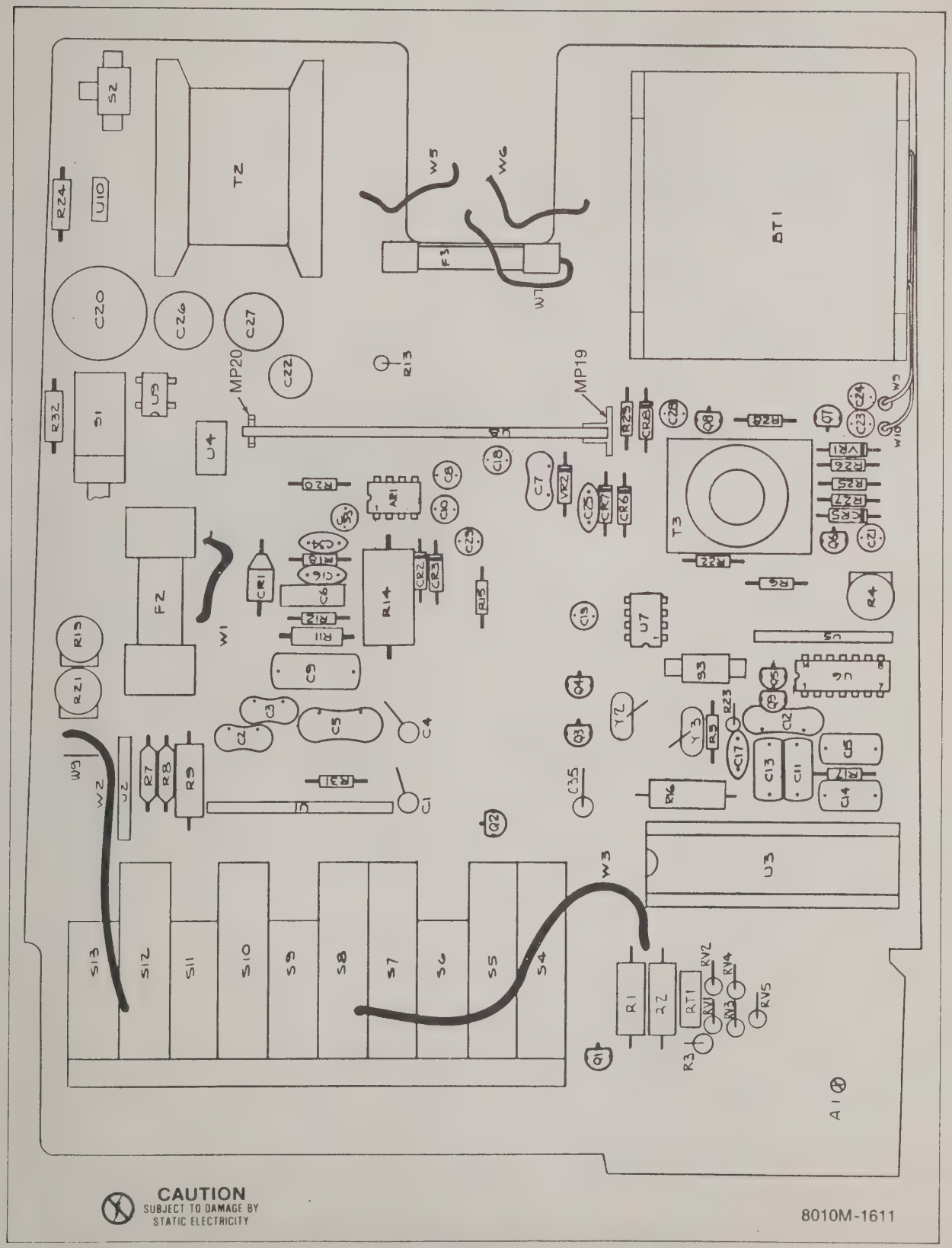

Figure 601-1. A1 Main PCB Assembly (-01 Option)

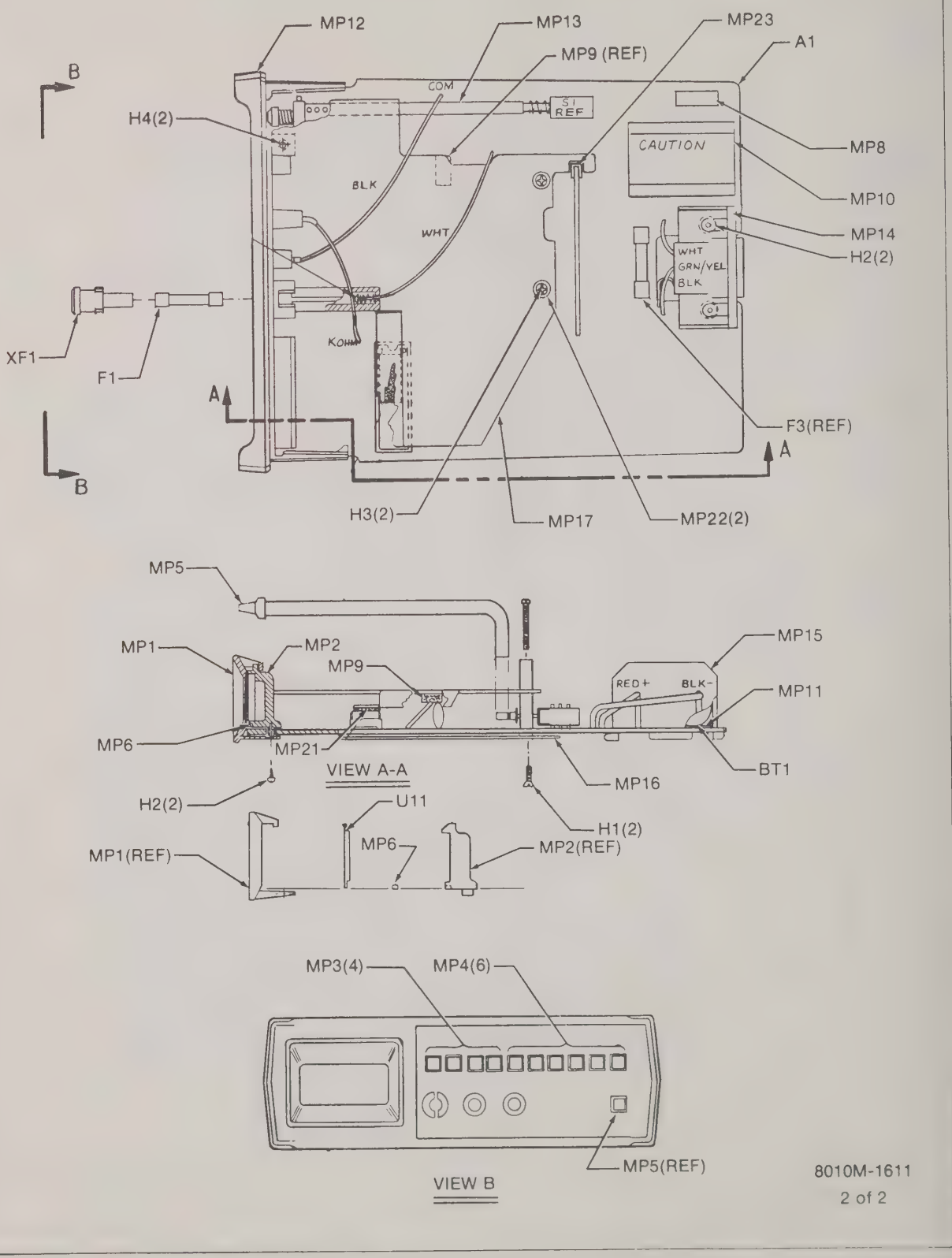

Figure 601-1. A1 Main PCB Assembly (-01 Option) (cont)

Appendix 7A
Manual Change Information

INTRODUCTION

This appendix contains information necessary to backdate the manual to conform with the earlier pcb configurations. To identify the configuration of the pcb's used in your instrument, refer to the revision letter (marked in ink) on the component side of each pcb assembly. Table 7A defines the assembly revision levels documented in this manual.

NEWER INSTRUMENTS

As changes and improvements are made to the instrument, they are identified by incrementing the revision letter marked on the affected pcb assembly. These changes are documented on a supplemental change/errata sheet which, when applicable, is inserted at the front of the manual.

OLDER INSTRUMENTS

To backdate this manual to conform with earlier assembly revision levels, perform the changes indicated in Table 7A-1.

Table 7A-1. Manual Change and Backdating Information

Ref Or Option No.	Assembly Name	Fluke Part No.	* To adapt manual to earlier rev configurations perform changes in desending order (by no.), ending with change under desired rev letter																						
			—	A	B	C	D	E	F	G	H	J	K	L	M	N	P									
A1	Main PCB Assembly	649293	●	●	X																					

* X = The PCB revision levels documented in this manual.
● = These revision letters were never used in the instrument.
— = No revision letter on the PCB.

Section 8
Schematic Diagrams

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8-2.	Custom IC(U3) Block Diagram	8-4

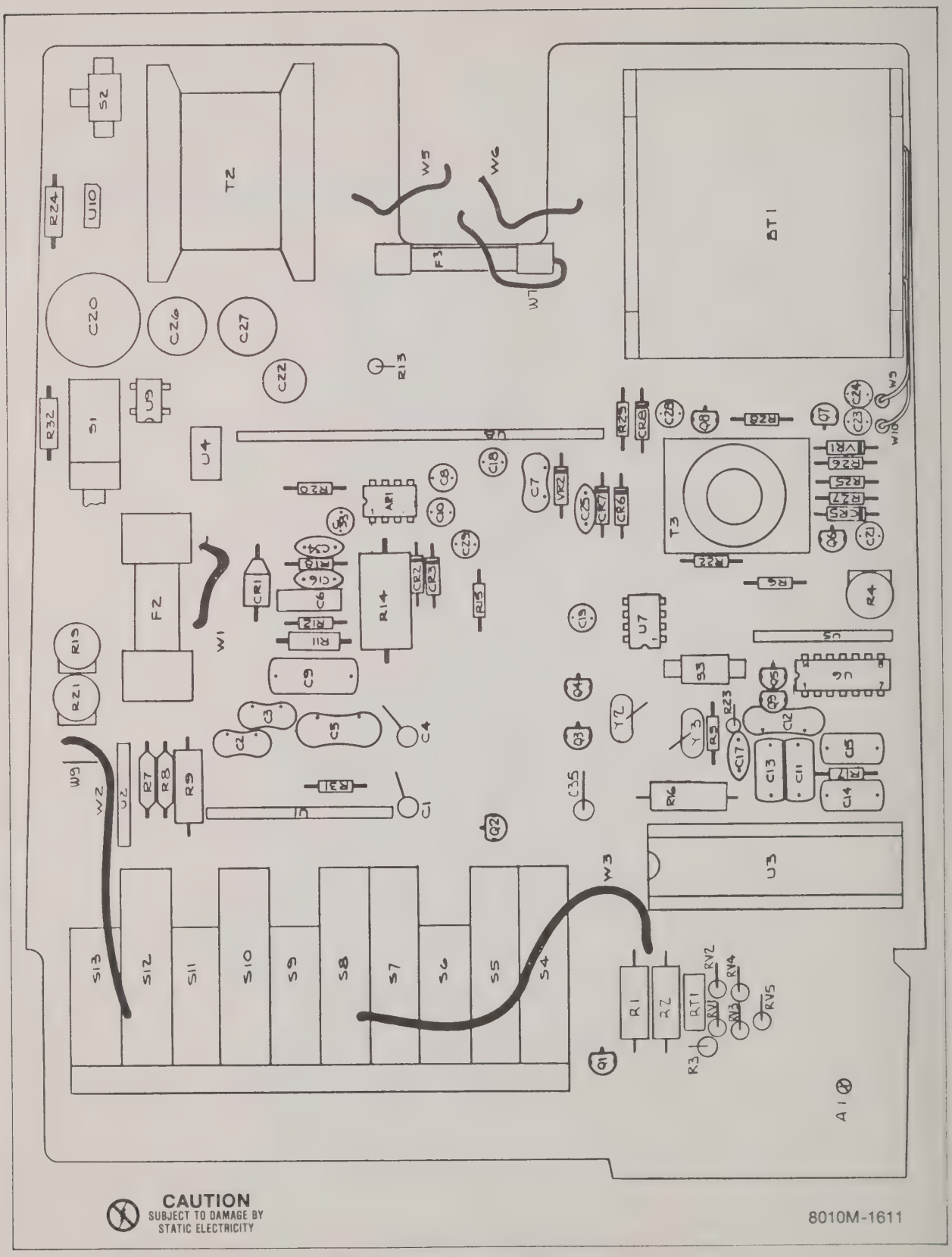

Figure 8-1. A1 Main PCB Assembly

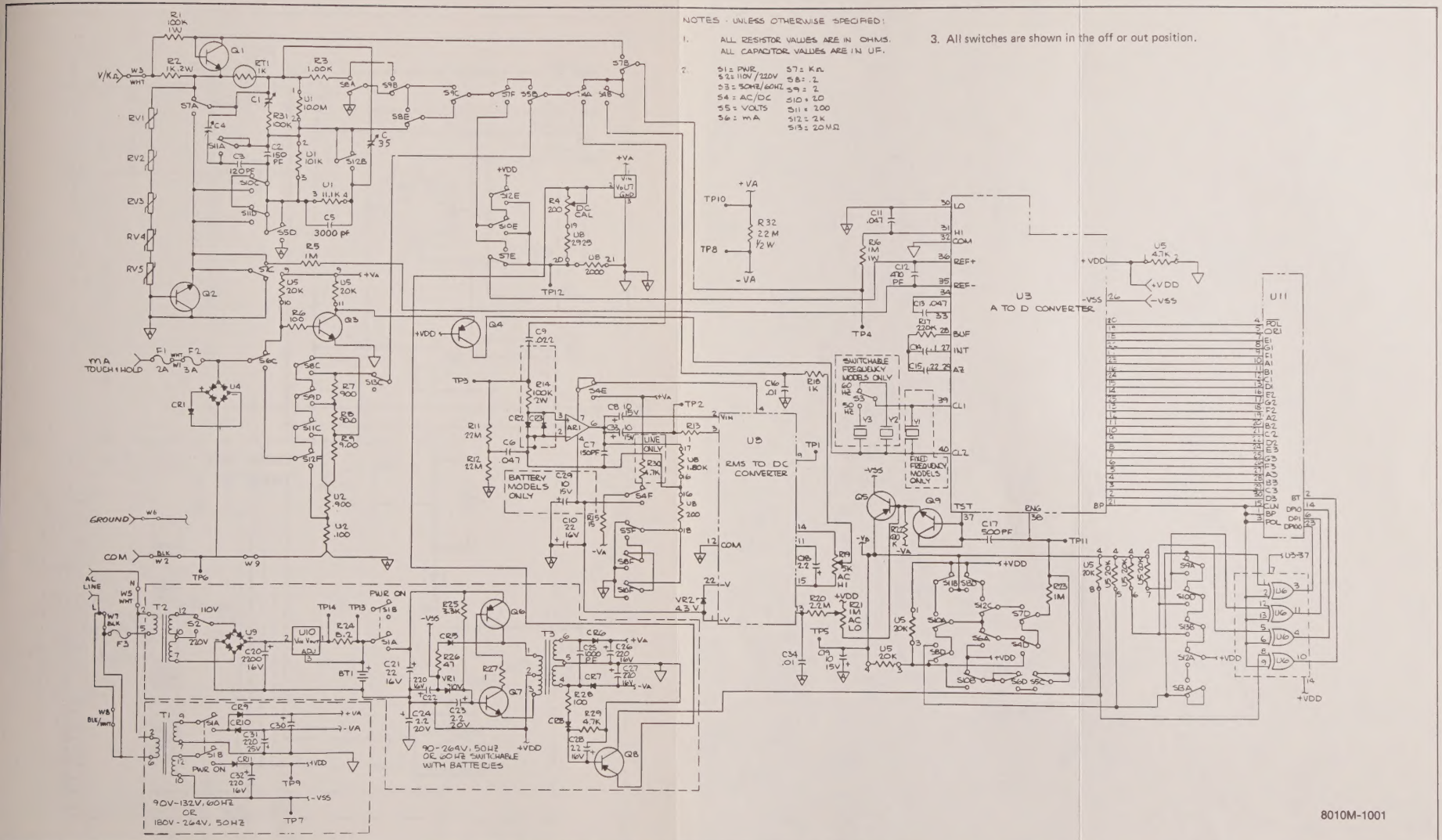

Figure 8-1. A1 Main PCB Assembly (cont)

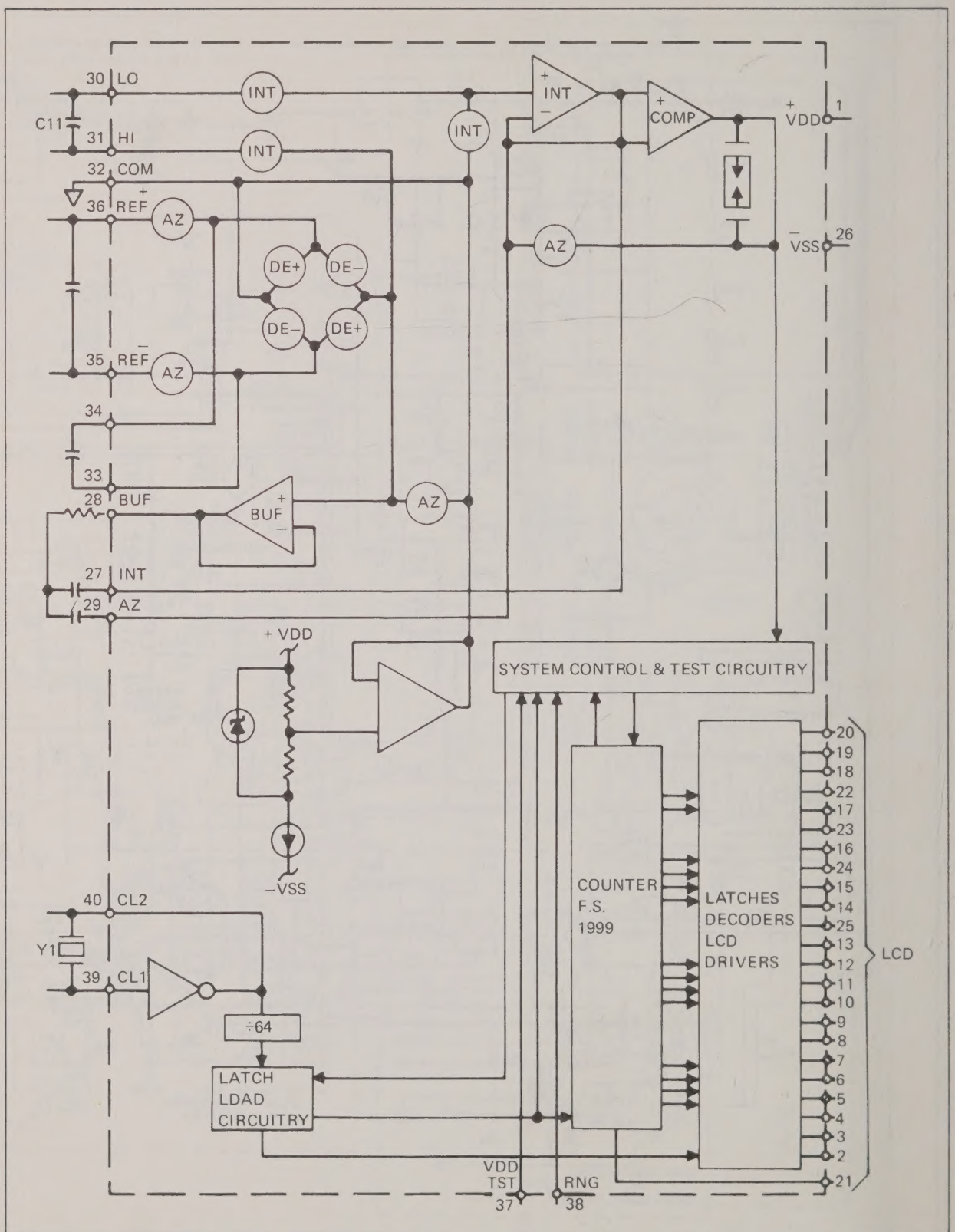

Figure 8-2. Custom IC (U3) Block Diagram

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